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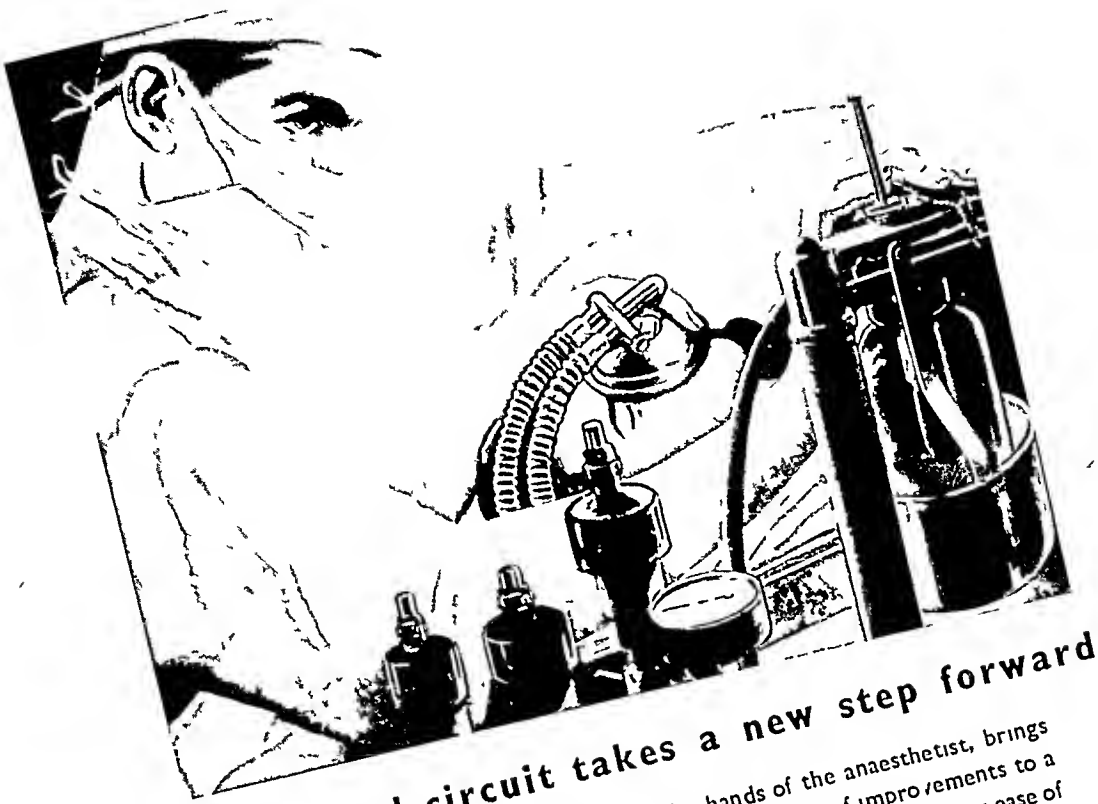

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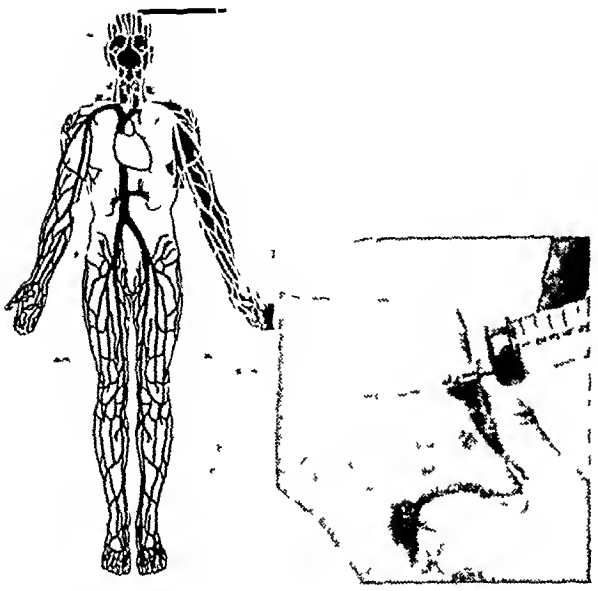

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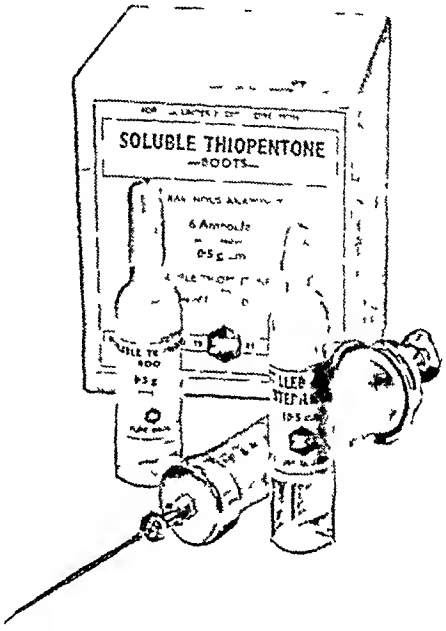

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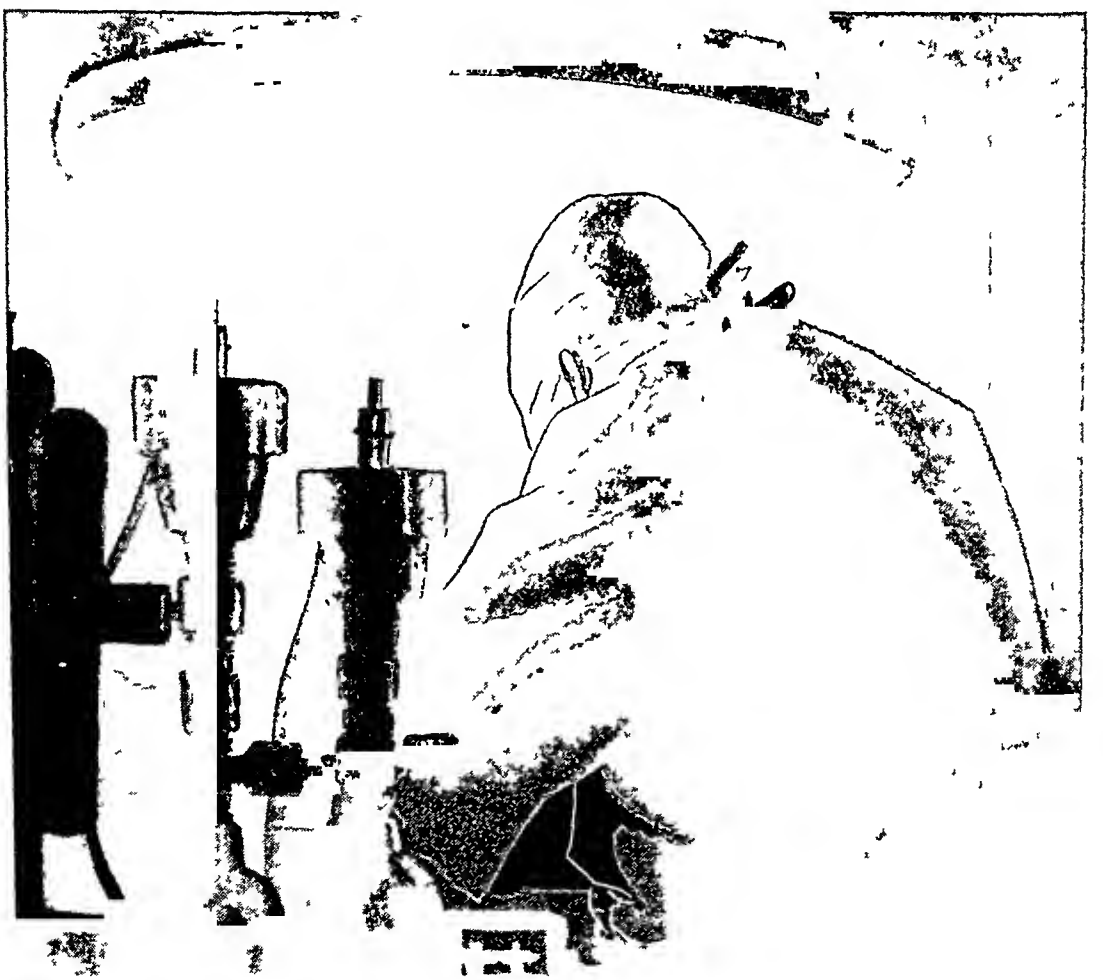

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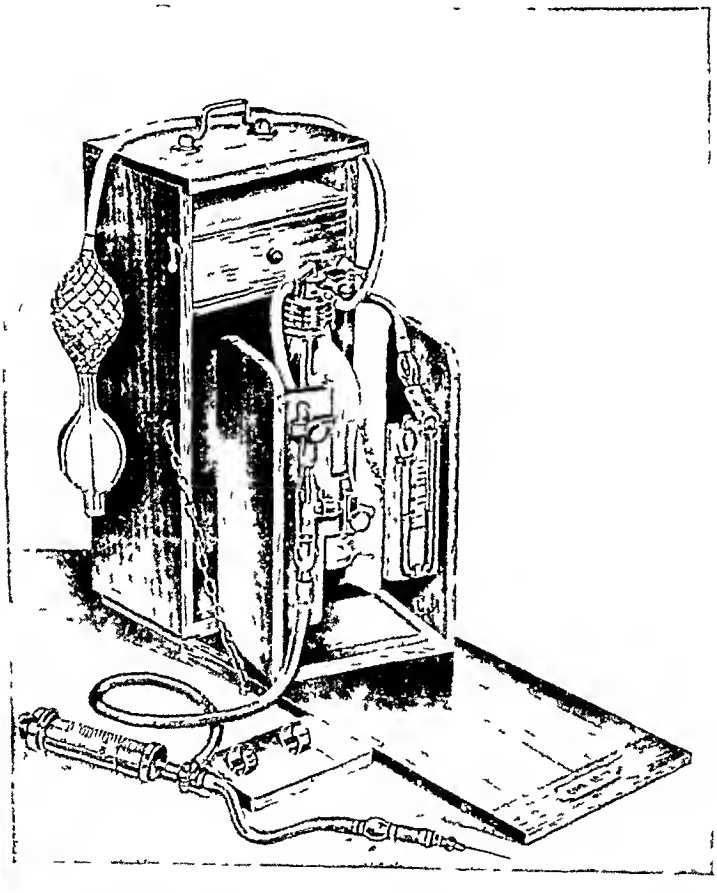

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British Journal of Anæsthesia

Vol XX, No 4 July 1947

THE EVOLUTION OF ANÆSTHESIA IN MANCHESTER, 1900—1945

By E Falkner Hill, M D

Lecturer in Anæsthetics, University of Manchester

AT the first meeting of the Manchester and District Society of Anæsthetists, a short paper on the evolution of anæsthesia from the beginning of the century seemed a fitting subject with which to open the proceedings, not only *pour encourager les autres,* but also to show the younger members of the Society that there had been changes, and that the inheritance upon which they were about to enter was a richer and fuller one than any to which we had succeeded Dr Blomfield thought a modified version might be of interest to a larger audience and so here it is

There have been five major changes in anæsthesia during this period They are

1 Premedication with its extensions, basal anæsthesia and the intravenous use of barbiturates

2 Oxygen, the general use of

3 Spinal Anæsthesia, the increasing use of

4 Magill's tube

5 Mechanization

We are too close to curare and cyclopropane, to electrical and refrigeration anæsthesia, to be sure that they can rightly be classed as coming under the heading of "Major Developments" Cyclopropane and curare are merely new drugs with some advantages and some disadvantages, electrical anæsthesia and refrigeration are certainly new methods but not yet sufficiently

established They may come under the heading of "Major Developments" in the next fifty years

Well, let us take a peep into an operating theatre any time between 1900 and 1907 What shall we see? Alexander Wilson will be there with a Clover's ether inhaler in hand Often he blew up the bag himself, more artfully he caught the patient's expiration whilst letting him inspire from the air around When the bag was three-quarters full the mask was fitted closely to the patient's face, and the pointer turned to mark one, and so gradually to mark four As the result of the conservation of the patient's expirations, the breathing deepened and the complexion, if originally rosy, rapidly changed to a deep plum colour The ether meanwhile had caused a copious secretion of mucus and saliva which added to the congestion, and a halt had to be called for mopping-up operations A gag was inserted into the mouth and a towel was used to absorb and remove as much of the secretion as possible, at the same time the patient had recovered his original colour owing to the entrance of air The proceedings were repeated as often as necessary It was a fairly quick method of getting the patient under, the accumulating CO_2 forcing the patient to breathe deeply It was this deep breathing that many operators objected to as it hampered their intra-abdominal manipulations and so they insisted on $CHCl_3$ The giving of $CHCl_3$ on lint to a patient for an abdominal section is a method of anæsthetizing calling for more skill than any other before or since Vernon Harcourt had introduced his inhaler to the Society of Anæsthetists as early as 1903, but it was a number of years later before it appeared in Manchester There can be no doubt that it was of great service in helping to carry out a prolonged operation under $CHCl_3$ The regulation of the dose gave one at least one certain factor, and in a situation full of uncertainties, it is a comfort to know something for certain Most of our younger members will never have seen a Vernon Harcourt till to-night and though

we no longer use it regularly, it is a good way to anæsthetize for a radical breast operation, if the surgeon expresses a wish for $CHCl_3$ as he not infrequently does From personal experience I can strongly recommend its use in obstetrics The inhaler is tied to the head of the bed, the pointer set to 1 per cent, the mask handed to the patient, who is told to fit it to her face and when she feels a pain coming on to take two or three deep breaths Such patients are very apt pupils The edge of every pain is blunted and if unconsciousness supervenes the mask falls off The obstetrician is aware of what is going on as he can hear the click of the valves If deep anæsthesia is required it is easy for the nurse to hold the mask on the face and the click of the valves tells the doctor that all is going well About this time also we first came across the Roth-Drager apparatus and this was really an epoch-making advance, in that it required the use of oxygen The actual apparatus did not survive long It is hardly possible for any apparatus when used by all and sundry to keep in usable condition for a reasonable length of time But we had realized the benefit of oxygen and from then on oxygen cylinders have been available in all theatres It was while using this machine that I saw my first death on the table The patient was diagnosed as suffering from a malignant growth of the thyroid In his endeavours to remove it, an heroic operation for those days, the surgeon pulled on the tissues of the neck and the patient stopped breathing, a little artificial respiration restored natural respiration and the operation continued More traction on the tissues of the neck stopped the heart this time Death was said to have been accelerated by the giving of an anæsthetic It would have been more correct to say that the anæsthetic had been unable to prevent a death which was so obviously caused by the surgeon Consideration of this case led me to give morphia and atropine as a preliminary injection The atropine in order to prevent vagus inhibition of the heart and the morphia as a sedative to nervous patients, to put them in a

more favourable state for the undergoing of an operation In the light of subsequent experience I have no hesitation in saying that this also was a very definite milestone on the road of progress in anæsthesia Twenty years later Ross Mackenzie of Aberdeen in a paper in the *Brit Journ of Anæsthesia* used these words, " Apart from the anæsthetic itself there is no single factor in anæsthesia that has afforded the surgical patient more physical and mental benefit and protection than the introduction of the preliminary injection of morphine and atropine or the equivalent "

You who would never dream of anæsthetizing a patient without a preliminary dose of atropine at least can scarcely realize what a tremendous innovation this preliminary injection of morphia and atropine was You will, if you try and anæsthetize the next two or three of your patients with ether without any premedication About a year later a Liverpool surgeon visited America and came back an enthusiast for open ether We went to see him operate under open ether and found that he used atropine but not morphia as premedication Subsequent experience seemed to teach us that atropine alone prevents 75 per cent of the post-anæsthetic vomiting to which we had been hitherto accustomed, and though the addition of morphia did nothing to enhance this effect, if anything there was slightly more vomiting, the soothing effect on the mind of the patient was of inestimable benefit We found that open ether was slow as compared with the Clover and so anæsthetists began to cover up their patients with gauze or gamgee tissue so as to conserve at least some of the CO_2, a partial return to the Clover idea

The next change, I am in doubt if we should call it an advance, came in the form of " Basal anæsthesia " Basal anæsthesia was first practised some hundred years ago, but scarcely became often used till Gwathmey introduced his ether oil rectal injection and not fashionable till avertin came in from Germany

A Manchester surgeon visiting that country in 1937 was told by a distinguished Berlin professor that the reason they employed it in Germany, though a bad method, was due to the dearth of competent anæsthetists The implication of that remark will not be lost on you If there be any sense in chemistry, and if as usually accepted $CHCl_3$ is dangerous because of its halogen content, then I cannot see why avertin is not more dangerous because it contains a more poisonous halogen in approximately equal amount Deaths following the administration of avertin for which no other cause could be advanced have been reported Langton Hewer mentions a case of severe vomiting and acidosis following avertin, gas and oxygen Acute yellow atrophy and ventricular fibrillation, this latter with adrenalin, have been reported in animal experiments It appears then that it has much the same action as $CHCl_3$ as one might expect from its chemistry The difference in the method of giving $CHCl_3$ and avertin is in favour of the former as that is stopped slightly before the end of the operation whereas it is obvious that the avertin continues to act for some time after the operation is finished Paraldehyde, recognized by most authors as the safest basal, is unpopular because of its smell and because it is more exacting on the nursing staff, albeit the sister who has had the longest experience of it prefers it to avertin Its lethal dose is in the neighbourhood of eight times that of its therapeutic dose whereas that of avertin is about two to one Both evipan and pentothal can be given per rectum but it is not so easy to estimate the correct dose for the particular patient The combination of latex with evipan and ether has been warmly recommended by Gwathmey and others The few trials I made of it scarcely warranted the enthusiasm expressed by Gwathmey, but they were too few upon which to base any opinion The preparation of the latex, the individual attention necessary and the way we have been circumstanced these last few years have proved too much for me to make an extended trial of the method, but I

think it has possibilities which are worth further examination Whether then we are to regard basal anæsthesia as a mere pandering to a soft and indulgent public, the trump card of the surgeon to persuade a reluctant patient to undergo an operation, the last refuge of the incompetent anæsthetist, or a real advance which protects the balance of the mind from disintegrating shock, prevents the occurrence of bronchitis or pulmonary collapse and the distress of post-operative vomiting is perhaps for the future to determine In the meantime it is a very pleasant way through the ordeal of an operation Avertin is much less used now than it was some years ago

The visit of Dr Pitkin about 1928 gave a great stimulus to spinal anæsthesia I gave my first spinal in 1912 but there was little call for this method until Mr Burgess took the matter up with his customary enthusiasm His encouragement and patience were solely responsible for giving me the opportunity of extensive experience in the method Very early on I found that everybody agreed that when the anæsthetic went too high we were in the presence of danger if not disaster There, however, agreement ended At least half a dozen different theories were advanced as to the cause of the fatal issue Thus the physiologist said respiration was paralysed but could not explain why artificial respiration was not always an effective remedy Observers from Boston said respiration was not paralysed but did not explain why death occurred From Canada we heard that the phrenics were paralysed but the respiratory centre was not Some Frenchmen said " C'est le moteur cardiaque qui est frappé " The late Dr Howard Jones suggested that the anæsthetic was absorbed into the blood stream and there paralysed the V M centre Many gave their opinion that it was due to a fall of blood-pressure, and Labat thought that a fall of blood-pressure was of no moment provided the patient was at once put into a definite Trendelenburg position A fine set of opinions with which to pass an examination but completely bewildering

when face to face with an emergency A series of experiments at the University enabled us to sift the wheat from the chaff and so to bring a confidence and an assurance into the work which was a great comfort in time of trouble Spinal anæsthesia is probably the best method of anæsthetizing patients for whom the method is suitable It is a method for the expert and for those of great clinical experience, the more the better It is not popular with anæsthetists for the very obvious reason that the responsibility is great and immediate and one is dealing with a living conscious human being who makes greater demands on one than an unconscious mass of snoring protoplasm Speaking of certain grave risk cases Drs Forgue and Basset say, "Toute intervention les menace, toute anesthésie risque de rompre, en quarante-huit heures, cet équilibre très instable Toute compte fait, il vaux mieux alors anesthésier ces malades a l'éther, à méthode ouverte, au goutte à goutte sur la compresse, le risque est moindre, et *la responsabilité moins immédiate*" The French express things so nicely Complications are rare, the commonest is headache, very occasionally this is severe

The secret of all general anæsthesia is the keeping of an open air-way, therefore when Magill introduced his tube not only into the trachea but also to the medical profession it was a notable advance Once this tube is in position through the nose and into the larynx most patients will anæsthetize themselves if connected with a suitable apparatus Of these there are many on the market, not all of them suitable, but all very expensive Their most important contribution has been to enable us to use the closed circuit technique

During this period $CHCl_3$ has been on the decline It is still of immense help in some difficult situations, better than anything else, as one would expect it to be as the most powerful anæsthetic we have All the older anæsthetists use it It may come again, it seems to be the way of the world, for is not every valley exalted and every mountain and hill made low?

INFILTRATION ANÆSTHESIA OF THE LOWER ARM AND HAND

By Dr L Tauber

IN the treatment of surgical diseases of the upper extremity, partly local and partly general anæsthesia are used The opinion of Kochert, that local anæsthesia is advisable only when contra-indication of narcosis exists, is no longer accepted We cannot lay down any general rule as to the best types of anæsthesia to be applied, for example, the age of the patient or his psychic disposition has often induced us to complete under narcosis an operation which is normally carried out by employing only local anæsthesia On the other hand, it may happen that the patient's fear of narcosis is so great that in order to avoid it he is ready to bear even considerable pain However, whatever the method the surgeon employs, his aim is always to carry out the operation with the minimum of pain This can only be achieved through the choice of drugs of the appropriate kind and quantity and through the use of correct methods correctly applied

The oldest, as well as the best known methods of analgesia, employed in surgical treatments of the upper extremity, are the two evolved by Oberst and Kullenkampff The first of these, though simple, is not in all cases without danger, as we shall see later The second, besides requiring specialized technical skill, also leads in a certain number of cases, not only to unpleasant symptoms such as paralysis of the cervical sympathetic system, blocking of the phrenic nerve and pain in the chest, but also to serious collapse, pneumothorax and even death On account of these dangers, these methods can certainly not be employed for ambulant cases

In the last century, Korning and Goldscheiner investigated the problem of infiltrative anæsthesia In animal experiments,

they succeeded by the injection of anæsthetic solutions into the prepared nerve (i e by endoneural injection) in making the area supplied by the nerve completely insensitive Soon they were able to demonstrate that analgesia could also be obtained, though more slowly, by perineural injection, that is, by allowing the anæsthetic fluid to reach the immediate surroundings By systematic investigations, they also showed that the nearer this injection is to the site of operation the smaller the actual amount of solution required

Endoneural methods of peripheral infiltration anæsthesia can be used with complete success, only when the nerve passes over bone or lies within a bony canal, for example, the brachial plexus as it lies on the first rib, the ulnar nerve on the humerus or the infraorbital nerve in the infraorbital canal According to Braun, among the nerves of the upper limb, only the ulnar nerve in its groove can be anæsthetized in this way (after Krogius) Wiedkopf advocated the analgesia of radial and median nerves also, at the elbow and above the elbow, respectively The localization of these nerves, however, is made difficult through the lack of definite bony landmarks and so these methods could not become popular Although above the wrist there is still no sure bony guide to these nerves, anæsthesia in this region is more often performed

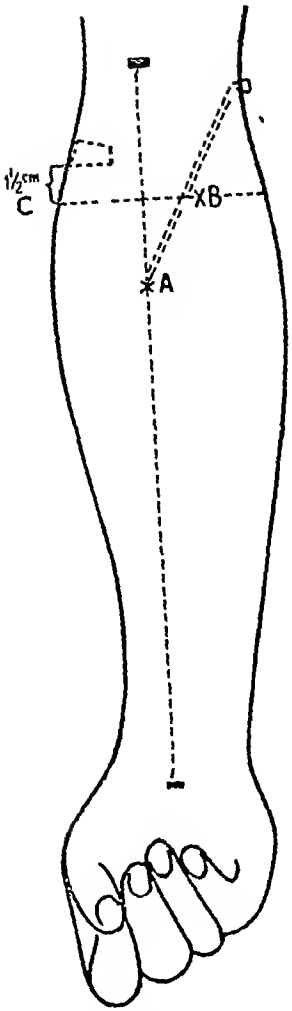
The inadequacy of peripheral infiltration anæsthesia in the upper limb led me to investigate further these two nerves Dissection showed that suitable sites for nerve puncture of the radial and median nerves exist also They are found as follows

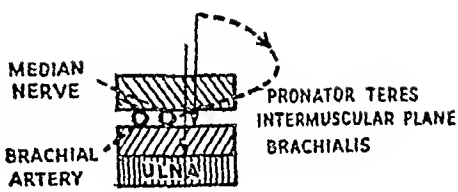
By the movements of pronation and supination of the lower arm the head of the radius is easily defined One and a half centimetres below this, a line is drawn perpendicular to the long axis of the arm In position of supination, from the junction of the thenar and hypothenar eminences, a line is drawn at right angles to the former The radial nerve lies at a depth of about one and a half centimetres, directly on the bone, below the point

of intersection of these two lines and can be reached by a perpendicular thrust of the needle In the case of a successful nerve puncture, the patient experiences an electric sensation, if this reaction does not occur the nerve will be found by deviating the needle a few millimetres from the perpendicular The location of the median nerve is not quite as simple, but with a little practice it too can be anæsthetized The method is as follows

By pronation and supination, the lateral border of the Pronator Teres is defined Half a centimetre medial to this (thus avoiding injury to the brachial artery), level with the lateral epicondyle, the ulna can be reached by a perpendicular puncture of the Pronator Teres and Brachialis muscles The median nerve lies in the space between the two muscles As long as the needle is piercing both muscles, it cannot be moved from side to side By carefully withdrawing the needle, a certain depth will be reached at which, for the first time, its free movement will be possible This level corresponds to the intermuscular plane Here the needle is turned at an angle of almost 180 degrees and pushed carefully in a lateral direction, until a resistance is felt, which is caused by the median nerve In both cases, 5 to 10 cubic centimetres of 2 per cent novocain are injected after a successful nerve puncture

I have had the opportunity of testing the technique described above on twenty patients, two with fractures of the radius and eighteen cases of panaritium of the hands with definite lymphangitis In all cases, in twenty to twenty-five minutes, the whole area innervated by the nerves was made completely insensitive and all motor impulses were blocked The area was definitely hyperæmic as a result of paralysis of all the vasoconstrictor and vasodilator fibres In one case, though the sensory function of the radial nerve was eliminated, the motor functions remained unimpaired The effect lasted about one and a half hours As the cutaneous nerves can easily be anæsthetized by simple subcutaneous circular infiltration, complete insensitivity of the





whole lower arm and hand can be achieved without the infiltration of the brachial plexus

Indication In all those cases of finger panaritia, where an accompanying lymphangitis reaches the first phalanx, Oberst's infiltration method cannot be used Should the patient have also myocardiac lesions, a contraindication of narcosis also exists At our present stage of knowledge, the only possible alternatives would be freezing or Kullenkampff's anæsthesia Freezing is the simplest form of analgesia, though probably few patients who have suffered from this method would consider that

it deserves the name anæsthesia The latter is a complicated procedure and can be dangerous as explained before It is also contraindicated in cases of pulmonary tuberculosis, emphysema, that is, in those diseases where narcosis is also out of the question. It is then evident that in these patients, the infiltration anæsthesia of the lower arm is the only possible method In Oberst's method, the locally administered solution causes a mechanical compression of the vessels In advanced cases of pyogenic processes of the finger, especially if arteriosclerosis or diabetes is also present, this mechanical compression may lead to irreparable damage, by gangrene setting in In the infiltration anæsthesia of the lower arm, this danger does not arise, for the fluid is applied at some distance from the site of the operation and, furthermore, is accompanied by extreme vasodilation In closed fractures the simple local anæsthesia is excellent, but in serious injuries and open fractures the infiltration anæsthesia of the lower arm can again well be employed According to Cryle, intraneural injection of novocain also diminishes the shock

Summary With the infiltration anæsthesia technique of the lower arm, a new indication can be established and the complications of narcosis can be avoided It is indicated in all those surgical diseases of the lower arm and hand, where the more dangerous and complicated Kullenkampff method or general anæsthesia are not desirable

THE PERMANENTLY PATENT (P.P) INTRAVENOUS NEEDLE

By EMILY E JOHNSON, M B, Ch B., D A

Consulting Anæsthetist to the E M S, West Riding County Hospitals, Clayton Hospital, Wakefield, and Dewsbury General Infirmary

EVERY one with experience in intravenous therapy or intravenous anæsthesia realizes that the two great difficulties are.

1 Keeping the needle in the vein
2 Keeping the needle patent

Methods now in use to obviate these difficulties are

a The tying of a cannula into a vein

b The use of a wide bore needle

c A drip feed

d A pressure drip feed

After much dissatisfaction with the above methods, I have now devised a stiletted intravenous needle which, fixed in the manner to be described, stays in the vein and remains patent for any length of time

The needle used is stiletted needle (stainless steel), two inches in length, 45 degrees bevel point, with a pin in the head of the stilette which fits into a notch in the hub of the needle It is made in various gauges from 23 to 17

A new type of strapping is used here, "Durex Cellulose Adhesive Tape", which has the following advantages It is quite transparent, tough, very adhesive and does not leave any glutinous residue on removal

Method of Use

1 Prepare lengths of cellulose adhesive tape and fold them over at one end to make for speedy removal. Three lengths should be 4–5 inches long and a fourth should be of such a length that it completely encircles the arm and overlaps for 2–3 inches The use of transparent strapping ensures visibility

2 Introduce the needle into the vein with stilette in situ and the notch in the needle facing upwards in order to facilitate reintroduction of the stilette When the needle is in position in the vein, gently withdraw the stilette and blood will flow

3 Pressure on the arm is gradually relaxed and the stilette reinserted

4 Fix the needle in position thus

Infold the vein by drawing together folds of skin from each side and fix in position by one of the short lengths of cellulose tape A second similar piece may be necessary to fix the overlapping folds of skin in position These overlapping folds of skin should extend about ½ inch beyond the tip of the needle and about 1 inch down its length Another short piece of strapping is placed over the lower inch of needle, thus fixing it directly to the skin It will be noted that only the hub of the needle is free from strapping

5 Remove the stilette to ensure that the needle is still in the vein (as the vein is not now distended it will take a few seconds for blood to appear) and reinsert the stilette

6 Apply the long piece of strapping over the needle, completely surrounding the arm and overlapping for 2–3 inches

N B The above operation should take 1–2 minutes (except where finding a suitable vein presents difficulties)

The needle is now in position and ready for the introduction of any drug or fluid The arm is then placed on an arm board covered with a sterile towel and the wrist fastened to it by a strap or bandage

Special Advantages

1 The use of transparent cellulose strapping permits visibility and thus minimizes the risk of not noticing a dislodgement of the needle Further it has the advantage of not leaving any glutinous material adherent to either skin or needle on removal

2 The 45 degree bevel aids venipuncture

3 When the needle is fixed in the manner described the vein will not be punctured by any movement caused by the attachment of syringes, etc

4 The fine bore minimizes trauma.

5 The additional length of the needle facilitates its fixation to the skin

6 No cumbersome intravenous apparatus is necessary requiring numerous assistants to transport the patient from anæsthetic room to theatre

Special Uses

1 The easy giving of fractional doses of any drug or antidote, by the intravenous route

2 The rapid attaching of any intravenous drip

Method of Giving Intravenous Drugs or Fluids

1 Remove stilette and place on a sterile towel or swab

2 Using record syringe inject drug or fluid

3 Immediately replace the stilette

It should be noted that a further injection may be given with an ensured patent needle still in position irrespective of the time interval At the end of the operation the needle may be withdrawn (alternatively a post-operative intravenous drip may be attached), care being taken that the strapping over the infolded vein is left in place, thus ensuring the asceptic healing of the venipuncture Pressure should be applied over the cellulose tape for a minute or two at the site of venipuncture immediately after removal of the needle to prevent any oozing of blood

Points Worth Noting

The p p needle is particularly useful for giving

1 Fractional doses of pentothal

2 Tubarine

Here, it is advisable to note the following facts concerning tubarine administration

Three syringes must be prepared as follows

A 5 c c for tubarine either undiluted or to give more accurate control diluted with sterile distilled water or N saline (thus 1 c c contains 3 mgm)

A 10 c c for sterile distilled water or N saline

A 20 c c for pentothal

The reason for using different sizes of syringes is to provide easy identification and to minimize the danger of giving the wrong solution In the event of using syringes of a similar size, different coloured tapes or named tapes should be attached to each particular syringe The stilette must now be withdrawn from the needle and the original dose of pentothal given immediately followed by a few c c of N saline

N B The N saline must be used to prevent the formation of a precipitate by the interaction of pentothal and tubarine

The stilette is replaced, after which nitrous oxide-oxygen anæsthesia may be commenced if desired

The patient is now ready for operative procedures

At the necessary moment the stilette is withdrawn and the calculated dose of tubarine injected, followed by a few c c of sterile distilled water or saline Should any further pentothal, tubarine, or antidote be deemed necessary these can be administered with complete immunity from precipitation if the routine of giving sterile distilled water or saline following each drug is adhered to Further it assures that the drugs are completely in the circulatory system

In every major surgical procedure whatever type of anæsthesia

be chosen, the p p needle in a vein may prove to be a life-saving factor It is immediately ready for any cardiac or respiratory stimulant, the introduction of pentothal for ether convulsions or for the attaching of an intravenous drip As an intravenous drip may be dislodged in transport from ward to theatre, the p p needle with stilette in situ makes possible the detaching of the drip before transport is commenced This means that the patient is without a drip for the few minutes of transportation but this disadvantage is more than offset by the p p needle being available to the patient for the drip immediately on arrival in the theatre

These permanently patent (p p) intravenous needles are made by Messrs Chas F Thackray, of Park Street, Leeds, and the " Durex Cellulose Adhesive Tape " by Durex Abrasives Ltd , Arben Road, Adderley Park, Birmingham

MUSEUM OF ANÆSTHESIA ESTABLISHED IN AUSTRALIA

By Len Barker

Photographs by Ken Dicker

THE Australian Society of Anæsthetists has established the third museum of anæsthesia in the world at Melbourne The only other known museums of its kind are in New York and London

Situated in the University of Melbourne, the museum was opened on October 16, 1946, coinciding with the centenary of the first successful public demonstration of a general anæsthetic

Far from being an exhibition of relics it is a modern school of instruction where the history of anæsthesia is traced for the benefit of medical and dental practitioners and students of those subjects at the University of Melbourne

The Society of Anæsthetists (which has a membership of 100) hopes through the museum to establish the following primary functions·

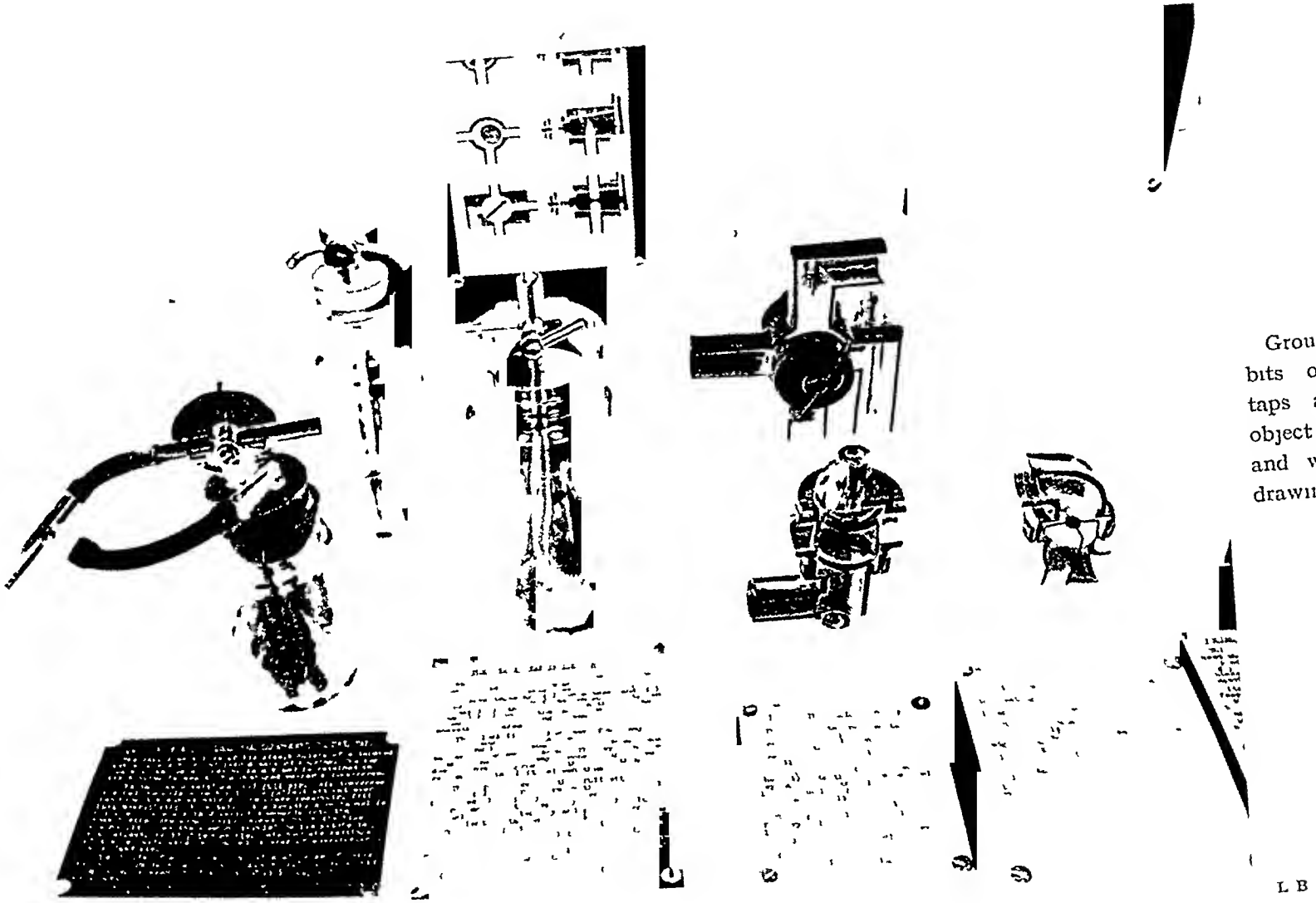
To provide scientific headquarters and a meeting place for the Society,

To foster post-graduate education in anæsthesia with particular attention to anæsthetists seeking senior qualifications,

To give basic training in anæsthesia to medical and dental students attending the University, and

To provide a liaison body between anæsthetists and manufacturers of anæsthetic drugs and appliances

The decision to establish a museum of anæsthesia was made in 1939, but the outbreak of war caused the plans to be

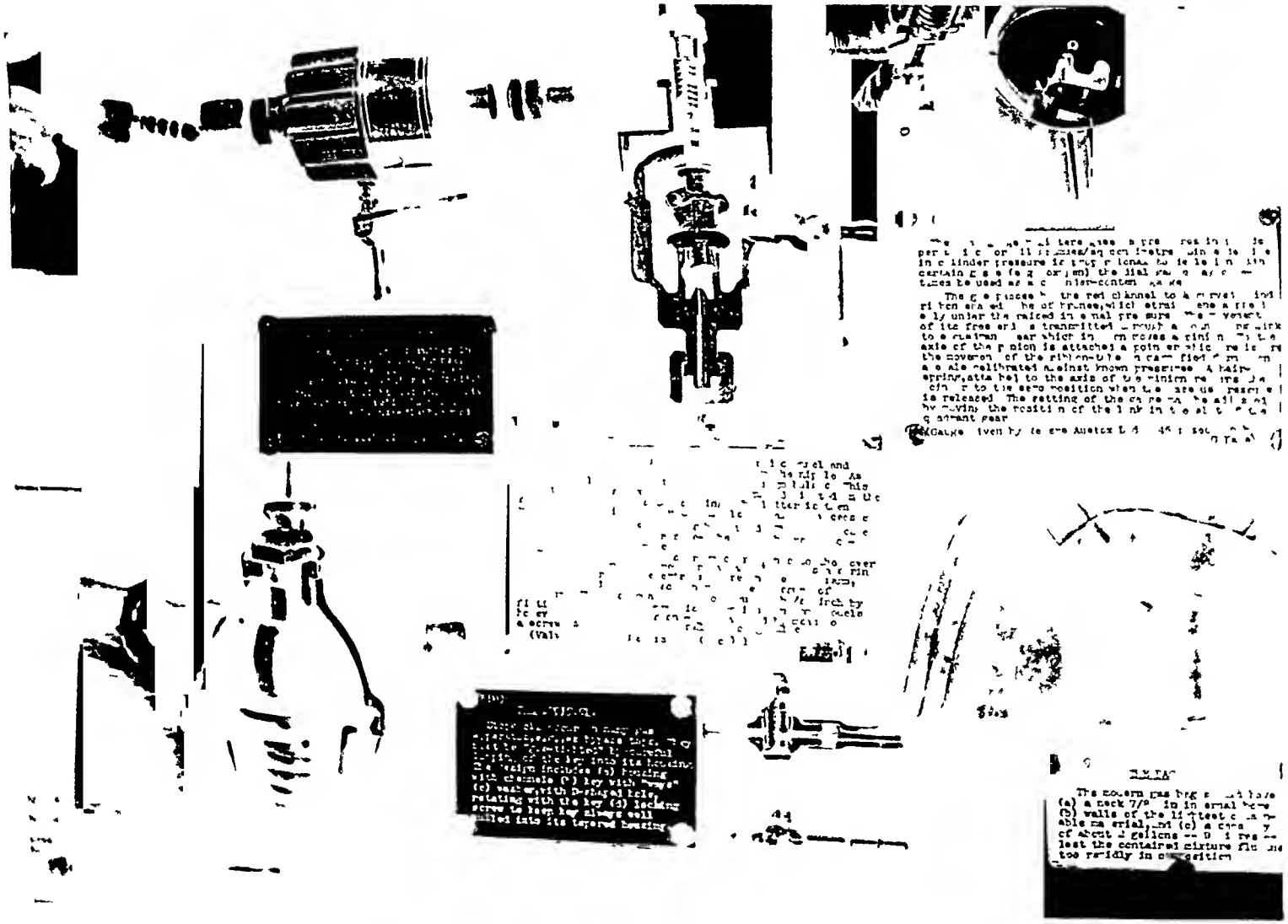


Groups of sectional exhibits of modern control taps and valves Each object is fully described and when necessary line drawings are employed

L B

Australian official photo

Museum of Anæsthesia established in Melbourne L 924

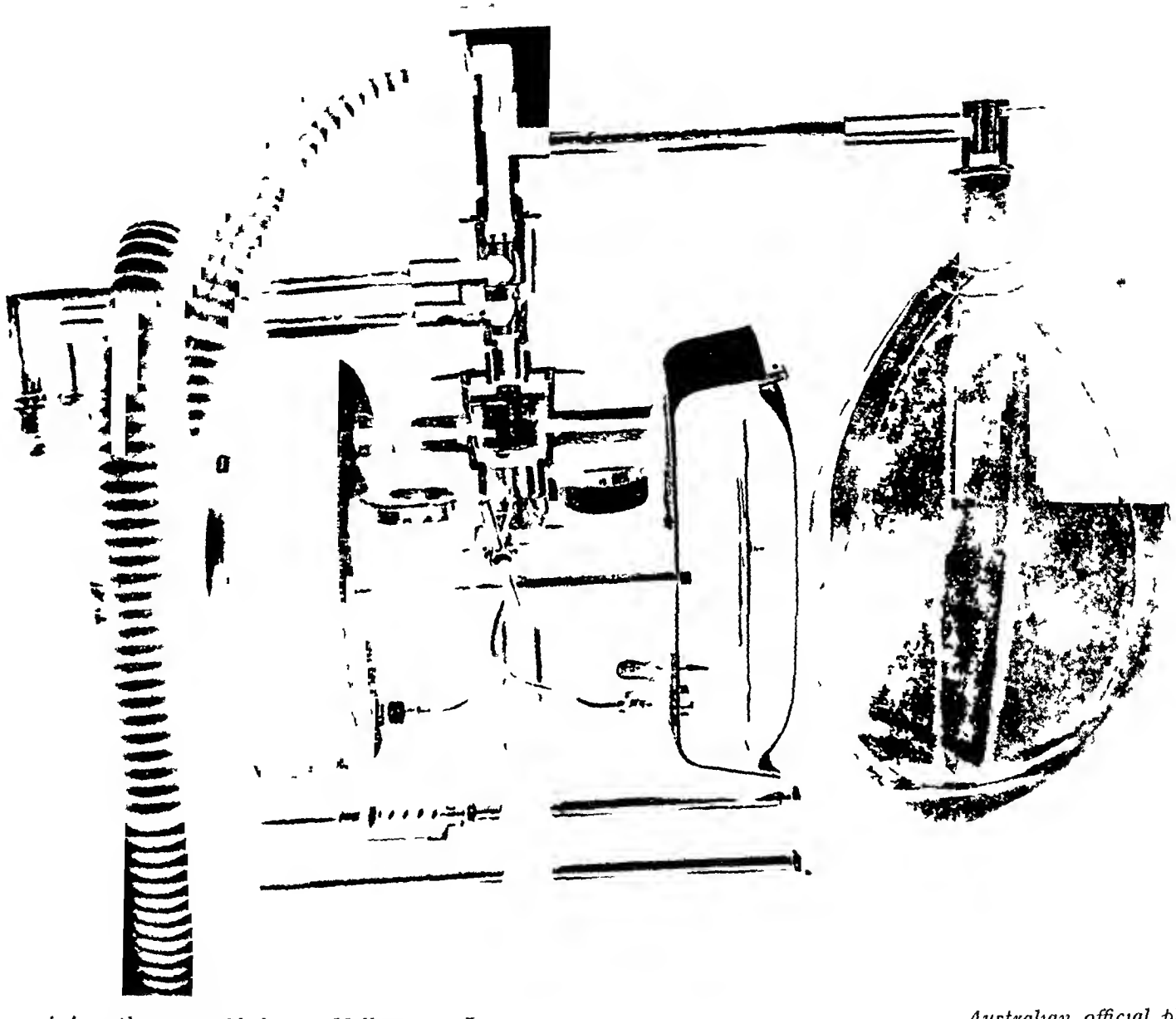


Reducing valves and their adjuncts are shown here in section and intact These also are served with explanatory and critical notes

M[illegible] of [illegible] established in Melbourne L 9-6

Australian official photo

L B



This section model of a comparatively modern gas-anæsthesia apparatus illustrates the method used in the museum for preparing and displaying exhibits

L B

Museum of Anæsthesia established in Melbourne L 927

Australian official photo

suspended In 1945 the Society started communicating with doctors, dentists, hospitals and manufacturers of instruments and drugs throughout Australia, requesting donations of suitable historical material The prompt response to the Society's circulars resulted in generous and helpful gifts from all parts of the Commonwealth Interesting exhibits of captured Italian and Vichy French instruments were also obtained from the Australian Army

In addition the Society obtained material for its museum by exchange with the American Society of Anæsthetists and the Association of Anæsthetists of Great Britain and Ireland The museum now possesses 1,000 exhibits

Space for the museum was made available by the Melbourne University's Physiology School, and although it was not as large as desired it was the best obtainable owing to the current shortage of buildings in Australia.

The museum occupies two rooms with a total floor space of 400 square feet One serves as an ante-room and office containing exhibits of large gas-oxygen apparatus, and current technical journals

The Society's reference library containing some 130 books (exclusive of journals) is housed in the nearby Medical School library so as to obtain the advantage of the services of a full-time librarian

Another satisfactory feature of the museum's location is its convenience to the laboratories of the Physiology School, which are open to members of the Society who wish to engage in research

The main display is set in the second room and is grouped in three categories historical, physiological and modern

Owing to space limitations the designers were forced to build the main showcases to a height of 10 feet A step ladder is available for visitors to the museum, however

The two rooms of the museum connect with a spacious

lecture theatre capable of seating 200 persons, which is used by the Society of Anæsthetists for formal meetings Its proximity to the museum allows lectures to be suitably illustrated by anæsthesia exhibits

The "theatre" is suitable for film projecting and the Society extensively uses 35 mm film strips and diapositives It also possesses 16 mm sound films but at present lacks the necessary projection equipment

Control and organization of the museum is vested in an honorary curator, who is responsible to the executive of the Society He possesses the qualifications specified by the Society for its curator

He is a medical practitioner with an extensive knowledge of the theory and practice of anæsthesia, an understanding of engineering as applied to anæsthesia, acquaintance with clinical photography and draughtsmanship, and experience in medical lecturing

Like many of his colleagues, he has an adequately equipped private machine-shop He made exhibits unobtainable from outside sources

The historical section of the museum is laid out in a large case measuring approximately 10 feet by 20 feet It covers as far as possible the evolution of anæsthesia from 1846 to 1930

Because medical equipment is usually metal-plated the exhibits are set against a black background, which shows them to the best advantage

It was found that black paint absorbs light and increases discordant reflection so this was countered by the installation of internal tubular lamps set in metallic troughs which are burnished internally and blackened externally They generate considerable heat, however, and to counteract the danger of fire and reduce consumption of power an individual switch and fuse has been fitted to each two shelves in every showcase

The historical exhibits are arranged chronologically with a

shelf devoted to each agent of anæsthesia. An explanatory card attached to each exhibit gives its history and pharmacology. The apparatus for the administration of each particular agent is then presented as far as possible in year groups, for example 1850–1857, "cone inhalers for ether", 1877–1907, "closed inhalers for ether", and 1905–1940, "open methods with ether"

The cards also explain the method of administration of each agent, the reasons for its introduction, its merits and defects, why it was superior to the methods which preceded it, and the cause of its subsequent discardment

Where the design of an exhibit is complex, models are duplicated in section with structural components emphasized in colour

Each exhibit (and the descriptive card which accompanies it) is marked with the shelf number and the serial number of the shelf

A card index is provided and a visitor wishing to locate any particular piece of apparatus can compare the shelf number with the card index

The primary aim of the modern section is to present the physiological basis of modern anæsthesia and apparatus of modern design acceptable to the standards committee of the Society Where any particular piece of apparatus has been found to be ill-designed the fact is uncompromisingly stated on the explanatory card

As anæsthesia is a highly technical subject the anæsthetist must be familiar with the combination of valves, flow meters, gauges and similar mechanisms into working apparatus, and every effort is being made to assemble a complete range of the standard types of these appliances

These exhibits are also in section with emphasis placed on the scope of each item and the Society's opinion of it In this way the anæsthetists or manufacturer of anæsthesia apparatus can see in a small space a wide range of modern equipment and gauge

from the explanatory cards the Society's opinion of their utility and constructional soundness

The exhibits are treated in much the same manner as those in the historical section with the exception that a separate case is devoted where possible to each agent or method such as gas, endotracheal, intravenous, and preliminary medication

As the physiological side of anæsthesia cannot be illustrated by exhibits of apparatus, this section of the museum is equipped with anatomical drawings and models, physiological diagrams and actual operation records

In the museum, the Australian Society of Anæsthetists has achieved its aim of presenting the evolution and steady progress in knowledge of respiratory and circulatory physiology and of the anæsthetist's ability to control those functions during a surgical operation

The Society has also demonstrated that a small group of enthusiastic technical workers can successfully establish a museum which can be educational while at the same time serving as a clearing-house for the exchange of ideas and information which are the basis of all scientific progress

ABSTRACTS

"The effect of carbon dioxide inhalation in the prophylaxis of respiratory complications"

(G H Gadesby in *Anæsthesia*, January 1947, p 12)

The patients had all been subjects of bonegraft operations, mostly to some part of the face Usually the necessary bone had been obtained from the iliac crest, thus causing "a great disturbance of the muscular activity employed in respiration, particularly coughing" The results of carbon dioxide therapy show reduction in total incidence of respiratory complications from 15 to 22 per cent, with possible reduction in their severity

"Analgesia and Anæsthesia in Obstetrics" Anæsthesiology, March 1947, p 113

The combination of demerol and scopolamine is reported to be unsurpassed by other agents and combinations in present use At Hartford Hospital the combination was given by the intravenous route and proved as satisfactory as barbiturate scopolamine medication

CONSULTANTS FOR INDIA AND BURMA

The Secretary of State for India and for Burma has, in recognition of their valuable service as Consultants to G H Q , India, during the war, appointed the following gentlemen to be Honorary Consultants to the India and Burma Offices

Brigadier S M Hepworth, M B , Ch B , D M R E —Consultant Radiologist

Brigadier G W Bamber, M D , F R C C P —Consultant Dermatologist

Brigadier E E Prebble, M B , Ch B —Consultant Venereologist

Brigadier D McAlpine, M D , F R C P —Consultant Neurologist

Brigadier E A Bennet, M A , M D , D P M —Consultant Psychiatrist

Brigadier H K Ashworth, M B , Ch B , D A —Consultant Anæsthetist

Brigadier the Hon G F O Bridgeman, M C , F R C S —Consultant Ophthalmologist

Brigadier Grant Massie, C B E , M S , F R C S —Consultant Surgeon

Brigadier J D S Cameron, C B E , M D , F R C P —Consultant Physician

REVIEWS

Anæsthetic Methods GEOFFREY KAYE with collaboration of R H ORTON and D G BENTON pp 706, illustrations and charts Price 50*s* (Australia) Barnsby (Surgical) Ptrs Ltd , Melbourne, Australia, 1946

This is a capital text book and in spite of war conditions appears to be most satisfactorily produced, but after all it is the matter more than the manner which is of most concern in a technical work, and for the matter there can be little but praise After a chapter on history and theory of anæsthesia the author describes the effects on circulation and elimination, then the signs of anæsthesia and the estimation of risks Here we think he might have laid more stress on the value of the breath-holding test, which is assuredly one of the most indicative—it is certainly the simplest of all these measures Resuscitation is next dealt with, and we note that he does not mention the peculiar amnesic effects of some barbiturates, which may become, as we have ourselves seen, very important in legal affairs as for example when a contract is repudiated which was made by the patient while still under the influence of an anæsthetic Later he may deny its validity, having completely forgotten committing himself while under barbituric influence

Throughout the book we were particularly pleased by the full and accurate descriptions of apparatus, we do not recollect ever having seen this matter so well dealt with in a text-book The book is called *Anæsthetic Methods*, but it is much more than this, for the physiology and the pharmacology of the subsequent results of various forms of anæsthesia are all fully considered After spinal analgesia, blood transfusion, fires and explosions are carefully described

The volume is completed by a chapter on death under

anæsthesia and one by D M Selby, Barrister-at-Law, for the Anæsthetist and Australian Law, and by discussion of recently introduced methods, including the use of curare Equipment for private practice is discussed in the appendix and some "useful data" There is in addition a good bibliography

The Development of Inhalation Anæsthesia BARBARA M DUNCUM pp 640, illustrated, 35*s* net Oxford University Press

Dr Duncum's introductory chapter alone is a capital epitome of the history of anæsthesia by inhalation Passing on to the main portions of the book she starts with an account of the unconsciously preparatory work of Humphry Davy, Levoisier and Beddoes We say unconsciously because although Humphry Davy certainly threw out the suggestion that nitrous oxide gas might be used to prevent the pain of operation, no one followed up his idea and he himself was concerned with the chemistry and physics, not with the medical application of his researches

Priestley's work on oxygen then comes into the picture and the subsequent extended practice of pneumatic medicine Ether vapour was being used therapeutically in 1796 Chapter II deals with Hickman, Long and Wells, Chapter III with Morton and etherization Then comes the advent of chloroform and Simpson's work at Waldie's suggestion, and Snow's great work in putting the administration of chloroform on a scientific basis, with definite percentages of the vapour Dr Duncum in her account of chloroform in practice pays much attention to its use in France in the 1850's Then comes an account of the chloro form committees in 1864 Part IV deals with the revived use of nitrous oxide and ether This was actually started by Colton of America in his dental practice In 1867 he demonstrated his method in Paris, where a great international exhibition was in progress Evans, a leading American dentist in that city, learned

from Colton how to make and administer nitrous oxide gas He came to London and gave demonstrations at the National Dental Hospital, Moorfields, and elsewhere Nitrous oxide was firmly established as the best anæsthetic for dental work Ether came to London in 1872 with Jeffries, an American ophthalmologist, who demonstrated its administration at St George's Hospital and elsewhere It rapidly grew in favour and this was increased by Clover's ingenious apparatus for giving it Ormsby's inhaler, too, found many adherents especially for maintaining anæsthesia after this has been completely induced by the gradual method made possible by Clover Between 1878 and 1885 most important contributions to the knowledge of anæsthesia and the principles by which is should be practised were made by Paul Bert Premedication with morphine came in about 1864, sponsored chiefly by Claude Bernard and by Nussbaum

Later chapters deal with the trial of ether by continental countries, the Hyderabad Commission, and anæsthetic trends in England, 1890–1900 A curious omission in this excellent and otherwise comprehensive book is any account of Magill's work on endotracheal anæsthesia

A Synopsis of Anæsthesia J A Zee, M R C S , D A pp 254, 42 illustrations, 12*s* 6*d* net John Wright and Sons, Bristol

The book starts with a synopsis of the history of anæsthesia under the names of those chiefly concerned in making it, from Priestley and Humphry Davy to Clover Then follows a list of the important dates Next comes a chapter on respiration, with illustrations of the parts concerned Pre-anæsthetic care and preparation and premedication are then dealt with The methods of inhalation anæsthesia are then briefly described and the stages and signs of anæsthesia The technique and agents for inhalation anæsthesia occupy succeeding chapters Types of apparatus and methods of administration are then described

The accidents of anæsthesia and their treatment are *briefly*

considered and this is followed by an account of the gases used in anæsthesia Endotracheal administration follows and after this rectal anæsthesia and basal narcosis with a brief contribution on rectal anatomy Intravenous anæsthesia and the barbiturates occupy following pages, then analeptics and spinal analgesia, complications and sequelæ of anæsthesia, another Anæsthesia and analgesia in labour provide material for the concluding chapter We can cordially recommend the book as a sound and useful summary of anæsthetic practice

The Chemistry of Anæsthesia JOHN ADRIANI, M D pp 530, illustrations and diagrams Blackwell Ltd , Scientific Publications, Oxford, 1946

This excellent and comprehensive work is divided into three parts inorganic chemistry related to anæsthesia, organic chemistry related to anæsthesia, and biochemistry related to anæsthesia Actually it deals also with the physical laws of gases, which are explained and exemplified Flowmeters, too, are illustrated and described in detail The diffusion of gases through rubber is discussed, and the physical methods of analysis of gases in body fluids and tissues "The distension of the bowel in intestinal obstruction is due almost entirely to accumulation of nitrogen within the lumen " Inhalation of 100 per cent oxygen through a semi-closed system establishes a gradient for nitrogen from tissues to blood, to alveoli, to outside air The gas is gradually eliminated from tissues and replaced by oxygen The use of an inert gas lighter than nitrogen is often desired as a diluent for oxygen in patients with an obstructed airway anywhere between the lips and the alveoli Helium is then of value, diffusing faster in and out of bronchi and alveoli and lessening the effort of ventilation

Dealing with CO_2 absorption methods the author points out the importance of the hardness and size of the soda lime granules employed The best canister is of 8 cm diameter, 13

cm long, with a volume of 650 c c., and accommodates 500 grams 4 × 8 meth. soda lime pellets.

The Common Cold NOAH D FABRICOURT, M D pp 123 Macdonald and Co Ltd , London.

At first the anatomy of the upper air passages is described and its functions in avoiding or accepting a cold explained The author has no new theory of causation and accepts the usually acknowledged virus and associated bacteria He attributes much importance to the weather and does not believe in the efficacy of habitual cold baths as a preventive Allergy and dyspnœa are considered, and the complications of the common cold For treatment he relies on the old and well-tried advice, " Get into bed and stay there " He advocates the humidifying at the same time as the heating of the air of rooms The good effect of treating air with glycol is stated and the advantage of germicidal lamps

The Conquest of Cancer GEORGE BANKOFF, M D , F R C S pp 187, illustrated 6*s* net Macdonald and Co Ltd , London

This is a good book for the lay reader It states in simple language the known facts about cancer and the surgical treatment of the disease and it is more optimistic than depressing Some of the author's statements however lack proof, as when he says that " the less condiments and spices one uses the less opportunity for cancer ", and that " spectacles, artificial teeth and glass eyes may act as irritants and cause the possible development of cancer " and that " policemen get cancer of the bronchial tubes and lungs through irritant fumes inhaled " He speaks of " fibrins, benign tumours which have their origin in connected tissue ", is this a commonly accepted term for benign tumours? Speaking of cancer of the stomach he says " the pyloric contraction is due to secondary anaemia ", surely it is the other way about!

CORRESPONDENCE

Sir,—I have just spent some considerable time reading Dr K E Madan's paper, "Spinal Analgesia with Sacral Escape", in the current number of the *British Journal of Anæsthesia* I say "considerable" because it appeared confused in composition and doubtful in validity Perhaps I may explain by reference to points in the order in which they occur therein

1 *Lines* 15–17, *p* 95 The author describes the effect on the spinal micturition centre as being "more pronounced" when drugs "like Stovaine, Amæthaine with 10 per cent glucose, heavy Nupercaine" are used, "particularly if alcohol has been used to lighten the specific gravity"

Does he mean to imply that he sometimes "lightens" his hyperbaric solutions by adding alcohol *or* is he referring to those manufactured *hypo*baric preparations which do contain alcohol? In the latter case, presumably the conjunction at the end of line 16 should read "or" instead of "and"

2 *Line* 25, *p* 96 Presumably the word "of" should read "or" and this is a typographical error

3 *Diagram* I, *p* 97 Having checked my first impressions by reference to both Gray's *Anatomy* and Samson Wright's *Physiology*, I still consider this to be a confused picture

(*a*) The pelvic nerve or *Nervus Erigens* ("Nervi Erigentis" is neither English nor Latin!) comprises the parasympathetic fibres arising from the sacral outflow of the parasympathetic system from S 2, 3 and 4 and *not* as here depicted, the sympathetic fibres from L 1, 2 and 3

(*b*) These fibres travel in the Pudendal Nerve (in the diagram referred to as the "Prudental Nerve"—perhaps another imprudent misprint!) and innervate *not only the* External Sphincter but the bladder itself and constitute the "emptying nerve" referred to in the diagram Also, they traverse the Vesical Plexus which is not only supplied with lumbar fibres as implied by the diagram

4 *Line* 2, *p* 98 "hemi-lateral" is an ambiguous word Literally it means "half of a side" which is not the same thing as unilateral, meaning "one side only" Thereafter the author refers only to unilateral analgesia and one can only deduce that he meant hemi-lateral to be a synonym for it

5 *Para* 2, *p* 98 If a patient who has had a hypobaric injection is turned on to his back and his thighs are "kept well flexed for another 3 minutes" the hypobaric solution is thereby *invited* to float up into the "sacral concavity" and it is difficult to see how his sacral motor roots will escape the effect of the drug since they are now higher than the lumbar roots which are the target of the manœuvre If, in Dr Maden's experience, the sacral roots do, in fact, escape with this method, it can only mean that all the drug has been "fixed" in the first 3 minutes and the patient might as well have relaxed his thighs

6 *Para* 3, *p* 98 By definition in all reputable text-books of anatomy, that part of the body "above the diaphragm" is the thorax and the only operations thereon must be thoracic and cannot be "abdominal"

It is also assumed that, in line 6 of this paragraph, "to" should read "from" and that what the author is really considering are upper abdominal operations close to but still below the diaphragm

7 *Line* 2, *p* 99 Having only described his techniques with heavy and light solutions, the author here claims to be equally successful with "isobaric solutions" Try as I may, I can only conceive of isobaric solutions either "staying put" or diffusing equally in all directions completely irrespective of the patient's posture I know of no commercial preparation of an isobaric analgesic solution and have always assumed that this was because one would have no control of its diffusion within the theca

8 *Conclusion* 1, *p* 99 I am not clear whether Dr Maden postulates a "sacral centre of micturition" *within* the spinal cord or in either the hypogastric vesical or presacral plexuses My own conception of it is as being *within* the lumbo-sacral cord in which case it is not "innervated *by*" the sacral nerves but is the origin *of* them

You must forgive me, Sir, for this long discourse on one article in your Journal While some of my criticisms are of the care which Dr Maden bestowed on his paper, others may prove to

be only of the meticulousness of your proof-readers Since the other papers in the same number and previous issues of the Journal have not carried so many errors I feel that the former may be the case and so you may care to refer my comments to him

I am led to make these comments, pedantic though some may appear to be, because I think that on all specialities—our own perhaps most of all—too much is written and published which is of too poor quality All too frequently the substance of a paper is not sufficiently worth-while, its " findings " are not statistically significant or its composition as a piece of English prose is unworthy of a graduate in what should still be able to command respect as a learned profession.

I feel that these considerations should apply especially to a specialist journal of infrequent publication and limited paper space

I therefore hope these criticisms will be accepted in the constructive mood in which they are offered

DONALD V BATEMAN, M B , B Chir

OBITUARY

DR SAMUEL JOHNSTON OF TORONTO

DR SAMUEL JOHNSTON died suddenly at his home in Toronto on April 14th last following a coronary occlusion. He was seventy-eight years of age and had been retired from active practice for several years A few weeks prior to his death he had undergone a major operation from which he appeared to be convalescing in a satisfactory manner, the symptoms of cardiac derangement arising suddenly and without warning Until the time of this illness he had been in his usual good health and spirits, his sudden passing coming therefore as a shock to his many friends His wife, Margaret MacCallum Johnston, survives him

After a few years devoted to a business career Dr Johnston entered Trinity College at Toronto in 1897, from which he graduated in the remarkably short space of four years with the degrees M A , M D , C M Following graduation he entered the Toronto General Hospital as an interne In those days the administration of anæsthetics was all too commonly placed in the hands of the resident staff and in Dr Johnston's case it became apparent early that this young physician, in addition to being particularly interested in anæsthesia, showed unusual ability in this field

From the beginning of his career in practice his activities were directed mainly to anæsthesia He was named chief of the new departments of anæsthesia established in 1907, mainly through his efforts, in the University of Toronto and the Toronto General Hospital, posts which he held with distinction until the year 1935 In 1910 he visited clinics in England and France During his stay in London he spent some time anæsthetizing animals for experimental investigations then being undertaken by Sir Victor Horsley

Dr Johnston foresaw that anæsthesia was a science which would hold an increasingly important position among hospital services It is to his credit that early in his career he bent his energies towards interesting his students and internes in this branch of medical practice and encouraging them to adopt it as their life's work He added to his staff as the times permitted, giving unstinted support and encouragement to his associates and indeed to all anæsthetists with whom he came in contact He made every effort to keep his department abreast of the times In the years following the First World War, particularly, he missed few important scientific meetings of anæsthetists in America He was an outstanding figure on these occasions, with few of his contemporaries either in Canada or the United States able to speak with equal authority Those of us following in his footsteps in those years remember with pride his contributions

at these sessions When a subject of a controversial nature was in review his opinion, if not voluntarily expressed, was requested either from the chair or from the floor His own outstanding ability as an anæsthetist and the enthusiasm he was able to instil in the members of his own and similar departments in other Canadian hospitals did much toward laying the foundations for the establishment of anæsthesia in Canada as an important medical science and speciality While his reputation was international in scope, for many years he has been called the dean of Canadian anæsthesia, a tribute which he richly deserved

Many honours fell to Dr Johnston during his lifetime He was the first president of the Canadian Society of Anæsthetists and a past president of the Associated Anæsthetists of the United States and Canada He was chairman for one session at the meeting of the section of anæsthesia of the British Medical Association at Nottingham in 1926 The American College of Physicians honoured him by making him a Fellow He was a Charter member and a past president of the Toronto Academy of Medicine He served a term as president of his dinner club, the Æsculapian Society He was a member of the Westminster Central United Church and of the Rotary and Empire Clubs of Toronto

Dr "Sam" had many staunch friends in all walks of life and to these his home was ever open He and his charming wife were the kindliest of hosts Visiting anæsthetists particularly felt the warmth of their hospitality in many lands there are some who will feel that they have lost a friend

"His life was gentle and the elements so mixed in him, that Nature might stand up and say to all the world 'This was a man'" These words of Shakespeare seem so particularly applicable to Dr Samuel Johnston

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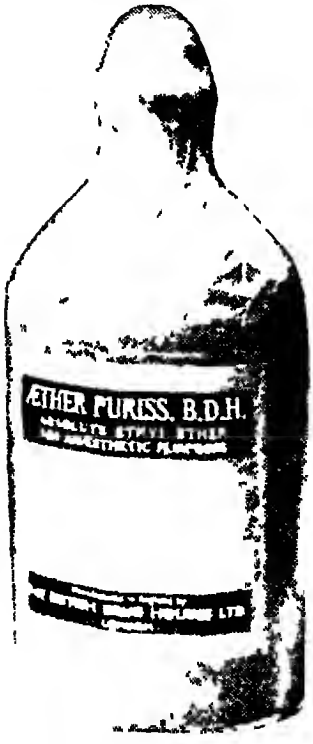

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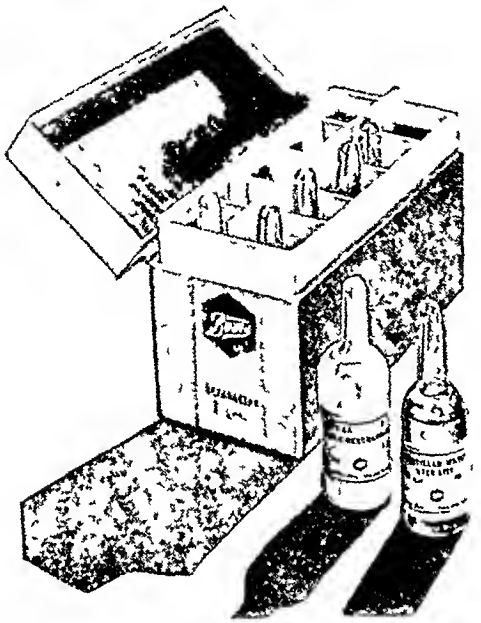

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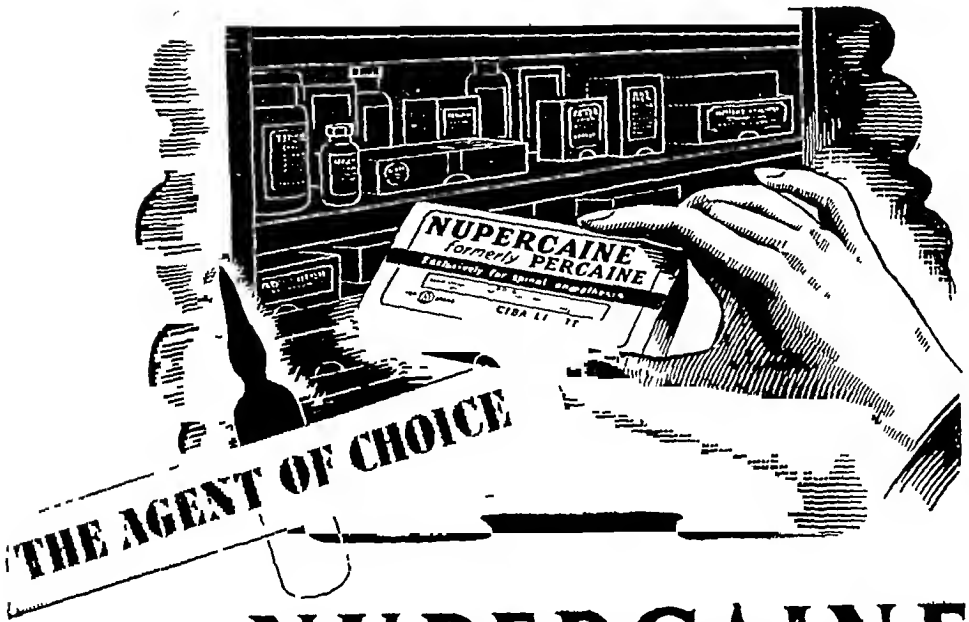

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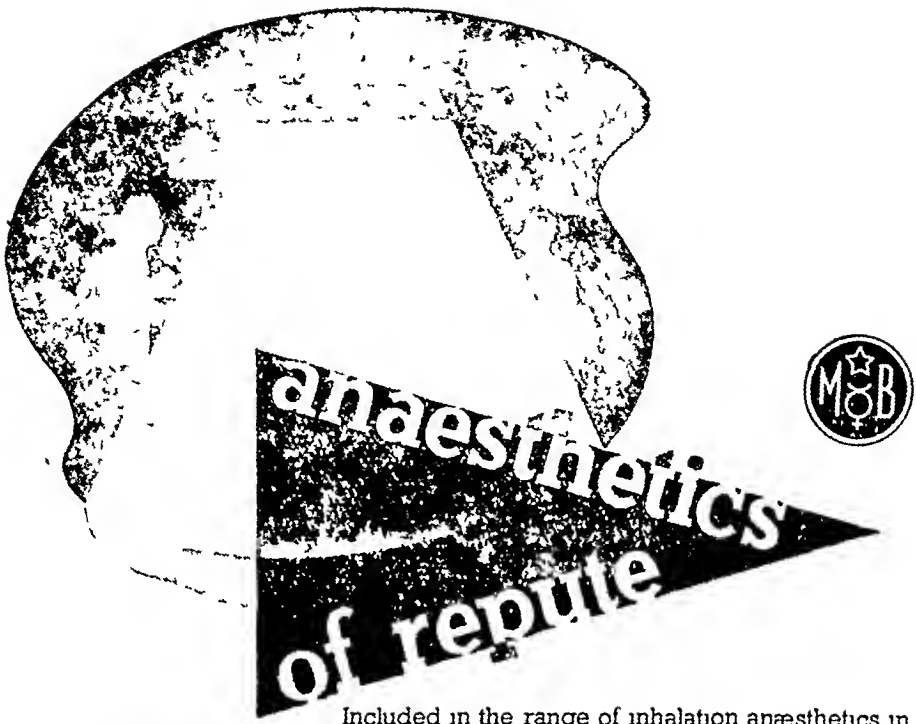

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ETHER versus CYCLOPROPANE

(A STATISTICAL COMPARISON OF CIRCULATORY COMPLICATIONS AFTER ABDOMINAL OPERATIONS)

BY

C EISENHART, Ph D, R A SIMPSON, M D, and N A GILLESPIE, D M, D A *

THE ultimate test of any anæsthetic agent or technique is the condition of the patient after operation Cyclopropane has now been widely used as an anæsthetic agent for eight years From its earliest days it was evident that it lacked the potency of ether as regards the inhibition of reflexes, and in the matter of the production of that muscular and peritoneal flaccidity which is commonly referred to as "relaxation" In 1934 Waters and Schmidt[1] wrote of it "In the lower part of the abdomen satisfaction has been complete for surgeon and anæsthetist Relaxation is ample For upper abdominal work noticeable defect in the relaxation has been evident in many cases" It was pointed out in the same paper that when high concentrations of the agent are used in order to obtain effective conditions of work for the surgeon sudden disorders of cardiac rate and rhythm are often encountered

The majority of anæsthetists have felt that in view of the pharmacological evidence, which has been the work chiefly of Meek and of Robbins and their associates, and has been ably summarized by the latter in his recent book,[2] the

* From the Departments of Mathematics and Anæsthesia, University of Wisconsin

occurrence of arrhythmia during anæsthesia was to be regarded as a sign of danger It was their concensus that the concentration of the agent should be lowered at once when an arrhythmia was observed [3] In 1940 Guedel[4] put forward the view that "cardiac arrhythmia occurring during cyclopropane anæsthesia, although they must be respected, need not be feared They are probably reflex in origin and subject to the same influences as other reflexes during anæsthesia They occupy a fairly definite range in cyclopropane anæsthesia, and anæsthesia can be conducted either above or below that range of concentration of cyclopropane" More recently Thienes, Greeley, and Guedel[5] have said that cyclopropane does not seem to be toxic to the heart except in the presence of anoxaemia

It has long been recognized that circulatory complications in the post-operative period occur more frequently after the use of cyclopropane than after that of ether [1] Kurtz *et al* [6] showed that arrhythmiae seen during anæsthesia with any agent often persisted for some time in the post-operative period Hewer[7] summarized the position in 1939 by saying "The figures for respiratory complications and vomiting were definitely in favour of cyclopropane, but those for circulatory complications and post-operative deaths told against the gas"

Nevertheless a number of anæsthetists still feel that this view should be conditioned by the fact that cyclopropane has often been the agent chosen for patients whose circulatory systems were in poor condition before operation They have thought that a patient who has been deeply anæsthetized with ether is more liable to remote circulatory sequelæ than a patient who has been similarly anæsthetized with cyclopropane This view was, however, founded on recollection of different patients, surgeons, institutions, and personnel, and not on recorded fact To test this hypothesis this survey of post-operative circulatory complications was undertaken Upon its result rests the question of whether or not, and irrespective of the complications encountered *during* anæsthesia, cyclopropane is as sound a choice of agent as ether for abdominal operations

The records of the Department of Anæsthesia of the Univer-

sity of Wisconsin make it possible to limit the number of uncontrollable variables in such a study The patients were all treated by the same teams of surgeons and anæsthetists, and these are composed of individuals of varying degrees of experience The records of all the abdominal operations performed in the Wisconsin General Hospital during the years 1938, 1939, and 1940 have been investigated by means of the system of Hollerith punched cards, which has been described elsewhere [8, 14] The records have been kept in accordance with the suggestions put forward by the Committee on Records and Statistics of the American Society of Anæsthetists In the course of the three years in question, cyclopropane has been more frequently used than ether as the agent of choice in abdominal cases This choice has been made, at the time, by the individual administering the agent, and it has depended on his opinion of the needs of that particular patient In 1938 ether was used in the majority of abdominal cases, in 1939 ether was used in 362 cases and cyclopropane in 483, whereas in 1940 ether was used 240 times and cyclopropane 640 times The results of this work, then, have not been conditioned by a preferential use of either agent Those few cases in which anæsthesia was obtained by the use of regional methods, or by means of some other agent have been excluded Where one agent was used to supplement another the case has been excluded unless it was clear that one agent was used only for induction The abdominal interventions were chosen for this survey because they require deeper anæsthesia than other operations for their smooth performance Since it is usually conceded that operations in the epigastrium require more profound anæsthesia and involve a greater strain on the patient's circulatory system, the operations above the umbilicus have been considered separately from the "lower abdominal" interventions In order that results in patients of similar condition might be compared, the patients were divided into (1) those with normal circulatory systems before operation, and (2) those with abnormal circulatory systems Each of these categories was then subdivided into "physical states" according to the classification laid down by the Committee on Records and Statistics of the American Society of Anæsthetists

of a larger numerical value than this is 085 on the supposition that cyclopropane and ether are equally liable to produce post-operative circulatory complications in patients of each of these physical states *

While not statistically significant when viewed in isolation from the other results shown in Table IA, the small proportions in the first three physical states, of cases free from post-operative complications with cyclopropane as compared with ether suggest, when considered in connection with the relatively few cases involved in physical states 4, 5, and 6 showing the same tendency, that cyclopropane is more liable to produce post-operative circulatory complications than ether This conjecture is further supported by the data in Table IB

Table IB compares the results with the two agents in patients suffering from disease of the cardiovascular system Although, as would seem probable, the absolute incidence of post-operative circulatory complications is higher than in the patients with normal circulatory systems, the relative incidence is higher after cyclopropane than after ether Here the numbers of cases involved in physical states 2 and 3 are sufficient for the application of the X' criterion, the values obtained being + 0 14 and + 1 85 respectively Both are positive but neither is statistically significant considered singly, nor are they statistically significant considered jointly, since (sum/$\sqrt{2}$) = +1 39- only If, however, we combine the three X' values based on the data of Table IA with the two X' values just obtained, we obtain (sum/$\sqrt{5}$) = +2 26-, a value definitely significant at the 05 level of significance (P = 024- in fact) Thus the data of Tables IA and IB on the relative frequency of cases free from post-operative complications with cyclopropane and with ether *for physical states* 1, 2, *and* 3 suggest that *in upper abdominal operations* cyclopropane is more liable to be followed by post-operative circulatory complications than is ether, and this

* The supposition here is that for physical state 1, say, the probability of post-operative circulatory complications following cyclopropane is the same as the probability of postoperative circulatory complications following the use of ether Similarly this supposition can be applied to physical states 2 and 3 There is no assumption here that the probabilities are the same from state to state

inference is independent of the other data in these tables, which, incidentally, further support this contention

In Table II the results of the lower abdominal operations are set forth in the same way Among the patients with normal circulatory systems (Table IIA) the results with the two agents are almost identical It is evident from the figures that post-operative circulatory complications are rarer after lower than after upper abdominal interventions In Table IIA the data for physical states 1, 2, 3, and 5 permit a X' analysis, and yield +0 96, +0 61, −1 61, and −0 02 respectively None of these are statistically significant at the 05 level considered singly and (sum $\sqrt{4}$) = −0 03 is clearly not significant Here we have come upon negative values of X' for the first time, indicating that in these instances cyclopropane was observed to give rise to *fewer* post-operative circulatory complications than ether In circumstances where cyclopropane and ether are *equally liable* to give rise to post-operative circulatory complications, positive and negative values of X' of the same magnitude are of equal probability The closeness of the composite X' obtained here (−0 03) to its expected value (zero) strongly suggests that in lower abdominal operations on patients with normal circulatory systems the chances of post-operative circulatory complications with cyclopropane and ether are identical The absence of any definite tendencies in the other figures of Table IIA supports this conclusion

Among the patients with disease of the circulatory system (Table IIB), however, there was a higher incidence of circulatory complications after cyclopropane than after ether Statistical analysis of this group shows that the patients of physical state 2 had more post-operative circulatory complications after cyclopropane than after ether, the excess being on the borderline of statistical significance at the 0 05 level, since $X' = +1\ 96$ For the data of physical state 3, the only other instance here with adequate numbers for a X' analysis, the value of $X' = +0\ 60$, which is clearly not statistically significant considered in isolation from other values Combining the X''s for physical states 2 and 3 gives (sum/$\sqrt{2}$) = +1 82, which is not statistically significant at the 05 level ($P = 0\ 07$) While this value may be said to hint

significance (at the 05 level) although none of these attain statistical significance (at this level) considered singly

At this juncture it may be noted that the X' values just presented constitute additional, but not entirely independent, evidence in support of the conclusions reached earlier from the comparison of cyclopropane and ether on the basis of the classification by physical states Thus, the above X' values for Table III considered collectively are statistically significant at the 001 level, since $(\text{sum}/\sqrt{3}) = 3\,45$ and $P = 0\,0006$, implying that in *upper abdominal operations* patients anæsthetized with cyclopropane are more liable to exhibit post-operative circulatory complications than patients anæsthetized with ether, at least in some circumstances On the other hand, the X' values for Table IV considered collectively do not quite attain statistical significance at the 05 level, since $(\text{sum}/\sqrt{3}) = 1\,68$ and $P = 0\,09$, so that while the data of Table IV seem to point to the conclusion that in *lower abdominal operations* cyclopropane is more liable to be followed by post-operative complications than is ether, the data here presented do not warrant this conclusion In the light of our findings from Table IIA and IIB the situation may be that in patients with diseased cardiovascular systems the above conclusion is true, while in normal patients cyclopropane and ether are identical in their effects This point could have been investigated by dividing Table IV into two tables one for patients with diseased cardiovascular systems, and one for patients with normal cardiovascular systems This investigation was not carried out as it was not thought of until after the sorting of the cards had taken place

Finally, there is a point not directly concerned with the agents cyclopropane and ether which may be examined with the aid of the data of Tables I to IV, namely, the relative incidence of post-operative circulatory complications following upper and following lower abdominal interventions Comparing the corresponding portions of Tables I and II it is seen that generally, although not without exception, the incidence of post-operative circulatory complications was greater after the upper than after the lower abdominal operations The situation is more clear cut in Tables III and IV, a comparison of the corresponding entries of which shows

quite definitely that post-operative circulatory complications are more liable to follow operations above the umbilicus than operations below the umbilicus, at least when the anæsthetic agent is cyclopropane or ether

Summary

By means of the punched card system an investigation was conducted into the incidence of circulatory complications during the period in the hospital following an operation performed with cyclopropane or ether The cyclopropane series consisted of 257 cases of upper abdominal, and 1268 cases of lower abdominal interventions In the case of ether, the corresponding figures were 435 and 531 The relation between pre-operative cardiovascular disease, physical state, the agent in use, and post-operative circulatory complications has been considered both for upper and lower abdominal operations These figures have been subjected to statistical analysis The relationship between the plane of anæsthesia and post-operative circulatory complications has been investigated in a similar manner

Conclusions

1 In a healthy patient subjected to anæsthesia for an upper abdominal operation, the tendency to circulatory complications is greater after cyclopropane than after ether, and is more marked among patients suffering from disease of the circulatory system

2 The incidence of post-operative circulatory complications is higher after upper than after lower abdominal operations

3 The data suggest that, after operations below the umbilicus, post-operative circulatory complications may be more liable to follow cyclopropane than ether anæsthesia, but the evidence is of insufficient strength to warrant this conclusion

4 With ether, the deeper the plane of anæsthesia, the greater the incidence of circulatory complications in the post-operative period In the case of cyclopropane this statement is true of lower abdominal operations It is probably also

true of upper abdominal operations unless "controlled respiration" is in use

The circulatory complications in the post-operative period, although of considerable importance, constitute only one of many factors which should be weighed when choosing the agent for use in any particular case The facts enumerated above should be applied in practice with the judgment which only extensive clinical experience can give

TABLE I

UPPER ABDOMINAL OPERATIONS

A Patients with normal cardiovascular systems, classified by physical state

1 Anæsthetized with cyclopropane Total cases, 149

Physical state	Total cases	No post operative complications Number	%	Minor complications Number	%	Major complications Number	%	"Fatal cases" Number	%
1	42	34	80 9	7	16 7	1	2 4	0	0
2	74	59	79 6	11	15 3	4	5 1	1	1 1
3	23	16	69 6	7	30 4	0	0	0	0
4	3	0	0	1	33 3	2	66 6	1	33 3
5	3	1	33 3	1	33 3	1	33 3	1	33 3
6	4	3	75 0	1	25 0	0	0	0	0
7	0	0	0	0	0	0	0	0	0
Totals	149	113	75 8	28	18 8	8	5 1	3	2 0

2 Anæsthetized with ether Total cases, 291

Physical state	Total cases	No post operative complications Number	%	Minor complications Number	%	Major complications Number	%	Fatal cases Number	%
1	107	96	89 6	8	7 5	3	2 8	0	0
2	117	130	88 4	17	11 6	0	0	0	0
3	30	23	76 7	4	13 3	3	10 0	2	6 7
4	2	1	50 0	0	0	1	50 0	0	0
5	4	4	100 0	0	0	0	0	0	0
6	1	1	100 0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0
Totals	291	255	87 6	29	10 0	7	2 4	2	0 7

* See definition of p 5

TABLE I

UPPER ABDOMINAL OPERATIONS

B Patients with disease of the cardiovascular system before operation, classified by physical state

1 Anæsthetized with cyclopropane Total cases, 108

Physical state	Total cases	No postoperative complications Number	%	Minor complications Number	%	Major complications Number	%	"Fatal cases" Number	%
2	52	40	76 9	6	11 5	6	11 5	1	1 9
3	47	30	63 8	13	27 6	4	8 5	2	4 2
4	3	2	66 6	1	33 3	0	0	0	0
5	1	1	100 0	0	0	0	0	0	0
6	5	1	20 0	2	40 0	2	40 0	2	40 0
7	0	0	0	0	0	0	0	0	0
Totals	108	74	68 5	22	20 4	12	11 1	5	4 6

2 Anæsthetized with ether Total cases 144

Physical state	Total cases	No post operative complications Number	%	Minor complications Number	%	Major complications Number	%	"Fatal cases" Number	%
2*	83	66	79 5	11	13 2	6	7 2	2	2 4
3	55	45	81 8	6	10 8	4	7 3	2	3 6
4	3	2	66 6	0	0	1	33 3	1	33 3
5	0	0	0	0	0	0	0	0	0
6	3	2	66 6	1	33 3	0	0	0	0
7	0	0	0	0	0	0	0	0	0
Totals	144	115	79 9	18	12 5	11	7 6	5	3 5

*By definition, no patient with disease of the cardiovascular system can be classified in physical state 1

TABLE II

LOWER ABDOMINAL OPERATIONS

A Patients with normal cardiovascular systems, classified by physical state

1 Anæsthetized with cyclopropane Total cases, 1020

Physical state	Total cases	No post operative complications Number	%	Minor complications Number	%	Major complications Number	%	"Fatal cases" Number	%
1	469	423	90 2	42	8 95	4	0 85	0	0
2	282	238	84 3	33	11 7	11	3 90	3	1 06
3	60	54	90 0	1	1 7	5	8 3	3	5 0
4	1	1	100 0	0	0	0	0	0	0
5	201	190	94 5	9	4 5	2	1 0	0	0
6	6	1	16 7	3	50 0	2	33 3	2	33 3
7	1	1	100 0	0	0	0	0	0	0
Totals	1020	908	89 0	88	8 6	24	2 3	8	0 78

TABLE II (*Continued*)

2 Anæsthetized with ether Total cases, 416

Physical state	Total cases	No post operative complications Number	%	Minor complications Number	%	Major complications Number	%	"Fatal cases" Number	%
1	209	194	92 8	14	6 7	1	0 5	1	0 5
2	133	116	87 2	15	11 3	2	1 5	1	0 7
3	22	16	72 7	2	9 1	4	18 2	3	13 6
4	3	3	100 0	0	0	0	0	0	0
5	43	40	93 0	3	7 0	0	0	0	0
6	6	5	83 3	0	0	1	16 6	1	16 6
7	0	0	0	0	0	0	0	0	0
Totals	416	374	89 9	34	8 2	8	1 9	6	1 4

TABLE II

LOWER ABDOMINAL OPERATIONS

B Patients with disease of the cardiovascular system before operation, classified by physical state

1 Anæsthetized with cyclopropane Total cases, 248

Physical state	Total cases	No post operative complications Number	%	Minor complications Number	%	Major complications Number	%	"Fatal cases" Number	%
2*	148	118	79 7	23	15 5	7	4 7	3	2 0
3	81	64	79 0	9	11 1	8	9 9	2	2 5
4	3	2	66 6	1	33 3	0	0	0	0
5	8	8	100 0	0	0	0	0	0	0
6	8	6	75 0	0	0	2	25 0	0	0
7	0	0	0	0	0	0	0	0	0
Totals	248	198	79 8	33	13 3	17	6 9	5	2 4

2 Anæsthetized with ether Total cases, 115

Physical state	Total cases	No post operative complications Number	%	Minor complications Number	%	Major complications Number	%	'Fatal cases' Number	%
2*	70	64	91 4	5	7 1	1	1 4	0	0
3	41	35	85 3	5	12 2	1	2 4	1	2 4
4	2	1	50 0	0	0	1	50 0	1	50 0
5	2	2	100 0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0
Totals	115	102	88 7	10	8 7	3	2 6	2	1 7

*By definition no patient with disease of the cardiovascular system can be classified in physical state 1

TABLE III

UPPER ABDOMINAL OPERATIONS

A Patients anæsthetized with cyclopropane Total cases, 257

Plane	Total cases	No post operative complications Number	%	Minor complications Number	%	Major complications Number	%	"Fatal cases" Number	%
1	4	3	75 0	1	25 0	0	0	0	0
2	53	40	75 4	11	20 7	2	3 8	2	3 8
3	94	64	68 0	23	24 5	7	7 4	3	3 2
4	106	80	75 5	15	14 1	11	10 4	3	2 8
Totals	257	187	72 8	50	19 4	20	7 8	8	3 1

B Patients anæsthetized with ether Total cases, 435

Plane	Total cases	No post operative complications Number	%	Minor complications Number	%	Major complications Number	%	"Fatal cases" Number	%
1	6	6	100 0	0	0	0	0	0	0
2	29	26	89 7	2	6 9	1	3 4	0	0
3	242	211	87 2	19	7 8	12	5 0	5	2 1
4	158	127	80 4	26	16 4	5	3 2	2	1 3
Totals	435	370	85 0	47	10 8	18	4 1	7	1 6

TABLE IV

LOWER ABDOMINAL OPERATIONS

A Patients anæsthetized with cyclopropane Total cases, 1268

Plane	Total cases	No post operative complications Number	%	Minor complications Number	%	Major complications Number	%	"Fatal cases" Number	%
Analg	1	1	100 0	0	0	0	0	0	0
1	26	26	100 0	0	0	0	0	0	0
2	626	557	89 0	53	8 5	16	2 5	6	0 96
3	384	327	85 1	42	10 9	15	3 9	5	1 3
4	231	195	84 4	27	11 7	9	3 9	2	0 86
Totals	1268	1106	87 2	122	9 6	20	3 1	13	1 02

B Patients anæsthetized with ether Total cases, 531

Plane	Total cases	No post operative complications Number	%	Minor complications Number	%	Major complications Number	%	"Fatal cases" Number	%
Analg	0	0	0	0	0	0	0	0	0
1	9	9	100 0	0	0	0	0	0	0
2	119	109	91 6	6	5 0	4	3 4	4	3 4
3	262	231	89 3	23	8 8	5	1 9	3	1 1
4	141	124	87 9	15	10 6	2	1 4	1	0 7
Totals	531	476	89 6	44	8 3	11	2 1	8	1 5

Appendix

The statistical analyses of this paper are based upon a modification of the chi-square method of analysis of four-fold tables, a discussion of which for medical readers is available in Chapter II of *The Treatment of Clinical and Laboratory Data*, by Donald Mainland, M B , Ch B , D Sc (Oliver and Boyd, Edinburgh, 1938) Denoting the four-fold table by

a	b	$a+b$
c	d	$c+d$
$a+c$	$b+d$	$a+b+c+d$

then

$$X^2 = \frac{N(ad-bc)^2}{(a+c)\,(b+d)\,(c+d)\,(a+b)}$$

Where $N = a+b+c+d$ Since, when the marginal frequencies are given, the entire table is determined by specifying a single one of the numbers in the interior of the table, this X^2 is said to have a single degree of freedom

F Yates[11] has shown that the accuracy of the X^2 method is considerably increased by a simple "correction for continuity" which is discussed on page 92 of Mainland's book Denoting this modified X^2 by X'^2, it is not difficult to show that

$$X'^2 = \frac{N(\ |ad-bc|\ -\tfrac{1}{2}N)^2}{(a+c)\,(b+d)\,(c+d)\,(a+b)}$$

where $|ad-bc|$ means the value of $(ad-bc)$ taken *positive*

For the purpose of the present study it has been advantageous to employ X' itself instead of its square, assigning to it a plus or minus sign according as $(ad-bc)$ is plus or minus In setting up our four-fold tables, we employed an arrangement which resulted in a + value of X' whenever cyclopropane showed a greater number of post-operative complications than ether, and a - value of X' when the reverse was true

Illustrative Calculation

The data for *lower abdominal operations* on patients with diseased cardiovascular systems in physical state 2 (Table IIB are

POST-OPERATIVE CIRCULATORY COMPLICATIONS

	Cases with some	Cases with none	Total
Cyclopropane	30	118	148
Ether	6	64	70
Total	36	182	218

$$X' = +(\,|(30)(64) - (118)(6)| \, - \tfrac{1}{2}(218)) \Big/ \sqrt{\frac{(36)(182)(70)(148)}{218}}$$

$$= +1103/558\,0 = +1\,98-$$

The Problem Our purpose in calculating X' in any case will be to answer a question which, in terms of the above illustration, may be expressed as follows Let p_c denote the *true* probability of complications following the use of cyclopropane, and let p_E denote the *true* probability of complications following the use of ether *for persons with diseased cardiovascular systems and in physical state 2 at the outset of a lower abdominal operation* Our problem is to decide on the basis of the data at hand whether $p_c = p_E$ or not

Solution A solution to the above problem can be obtained easily in view of the fact that X' as defined above will be distributed approximately normally about a mean of zero with unit standard deviation *in random samples* from a population in which $p_c = p_E$, provided the marginal frequencies are sufficiently large (For explicit conditions see the paper by Yates referred to above) Furthermore, under these same general conditions, X' will be normally distributed about a positive mean when p_c is greater than p_E and about a negative mean when p_c is less than p_E

With reference to the above illustrative data, we note that X' exceeds the 05 significance level ($\pm 1\,96$), so that *if the method of obtaining these data was equivalent to random sampling from the "population" specified by the underlined words in the statement of the problem*, then we may assert that p_c is not equal to p_E, and the probability of this assertion being false is less than 05 (In view of the borderline character of this result if one is using the 05 level of significance, one would probably wish to reserve a verdict

that p_c was greater than p_E until further data were examined.)

The underlined premise is important. In agricultural sampling the validity of this assumption is insured by consciously introducing a random operation (e.g. drawing cards from a hat, tossing dice, etc.) in the sampling technique. Since non-randomness of sampling from a "population" wherein $p_c = p_E$ could also result in an abnormally large X' such as the above, it is clear that information regarding the randomness of sampling is essential. In medical work of the type under consideration here, random sampling of patients is not feasible. Probably the best that can be asked is that the data employed include all persons whose general health is as described and whose difficulties were such as to require operative treatment of the type under consideration.

Combination of Several X' Values

When several, say k, X' values are at hand and it is desired to test the hypothesis that $p_c = p_E$ in all k cases, a composite test is obtained by calculating (sum X' values $/ \sqrt{k}$) and comparing this with the significance levels of a normally distributed variable with mean of zero and standard deviation of unity, tables of which are available.[12, 13] For ready reference we note the following levels:

P	.50	.25	.10	.05	.01	.001
X'	0.674	1.15	1.64	1.96	2.33	3.29

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A METHOD OF KEEPING ANÆSTHETIC RECORDS AND ASSESSING RESULTS

BY

MICHAEL NOSWORTHY, M D , D A

THE keeping of anæsthetic statistics is not new[1] and in recent years a most comprehensive punch-card system has been standardized by the Committee of Records and Statistics of the American Association of Anesthetists [2] The present aim was to combine on the same card the usual anæsthetic chart for collecting and recording all the relevant data as well as a method for assessing results statistically without having to use either a code book or a sorting machine The anæsthetic record to be described is printed on a card 8 inches by 5 inches in size

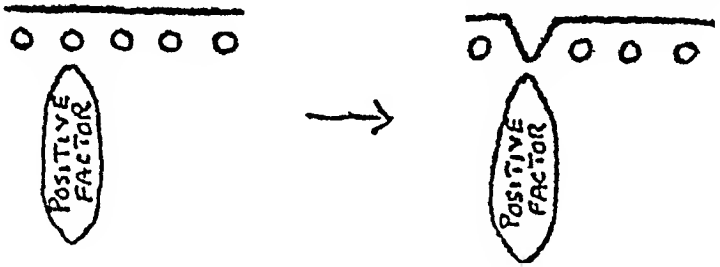
THE PRINCIPLE OF THE METHOD

Around the four sides of the card holes are punched What each group of holes and each individual hole represents is shown by headings and subdivisions printed against them on the front of the card (Fig 1) Whilst the operation is in progress attention is given to the back of the card (Fig 2) Details of the operation performed and the anæsthetic administration are filled in, positive factors are encircled, and observations are recorded on the graphic chart

This chart is divided by vertical lines into five-minute intervals extending over a period of three and a half hours—the actual hours of operation being written along the top of the chart The agents used are indicated by a solid line opposite the name or chemical symbol which appears on the extreme left The amount of oxygen added per minute—

when the CO_2 absorption technique is being used—is indicated by a line opposite the appropriate figure in the margin (e g 200 c c /MIN) The percentage of oxygen in the anæsthetic mixture—when open or semi-open gas techniques are being used—is indicated by a similar line opposite the appropriate figure from which the final "o" has been deleted (e g 20ø = 20%) The plane of anæsthesia is indicated by a line opposite the appropriate number 1, 2, 3, or 4 The figures from 0 to 200 at the side of the chart are used to represent the systolic and diastolic blood-pressures in millimetres of mercury, the pulse-rate in beats per minute, and the respiratory-rate per minute by placing characteristic marks at the proper levels The code at the side of the chart shows that check marks indicate the systolic and diastolic blood-pressures, small dots the pulse-rate, and small circles the respiratory-rate The beginning and end of the anæsthetic administration is recorded by a properly placed X, and a dot enclosed in a circle denotes the beginning and end of the operation Interesting happenings are explained by brief numbered remarks in the column provided and their timing denoted by corresponding numerals accurately placed at the foot of the chart [3]

From the theatre the records go to the anæsthetic department where each is issued with a serial number which, with the patient's name and the actual operation performed, is entered in a card index The data collected at operation, like other positive factors noted on visiting the patient during his stay in hospital, are subsequently marked with a circle in their appropriate subdivisions round the sides on the front of the card When the patient has left hospital the holes opposite the encircled positive factors are converted into slots by cutting out a "V" from the edge of the card opposite



each with a pair of special nippers or scissors During sorting, later on, the slots permit the separation of the positive factors from the negative factors the holes opposite which will still be intact

The preliminary ringing of all positive factors serves as a safeguard against the chance of a mistake in slotting Finally, as proof that the record has been completed and is now ready for filing, the corner marked with the diagonal line is snipped off

Sorting of a pack of completed records is accomplished by running a knitting needle through the hole representing the factor under consideration, by spreading the pack over its length in order to prevent any cards from clinging together, and then by raising the needle For example, if it is desired to find mortality figures the needle is passed through the hole marked "DIED," and the cards of all patients who died in hospital—since they will have had this hole slotted—will fall from the pack, whereas the rest of the cards, representing all patients discharged from hospital, will be supported on the needle—since they will have the "DIED" hole left intact By repeating this manœuvre it is possible to find quickly all statistical data required—e g the number of a given type of operation performed under a particular anæsthetic technique and the postoperative morbidity and mortality, etc

Cards must obviously all be "facing front" and also "right side up" before sorting is commenced All cards must therefore be filed away with the "cut-off" corner in the same relative position If the cards in a pack happen to become jumbled up, however, they may be quickly rearranged facing front and the right side up by inserting the needle first through one corner hole, lifting away the projecting cards and repeating this operation through two more corner holes This is the sole purpose for which the corner holes are used During sorting the pack of cards must be stood on the edge opposite to that bearing the hole through which the needle is to be passed, so that the slotted cards are free to fall from the needle

ANÆSTHETIC RECORD

No ____ WARD ____

HOSP ____

NAME ____ AGE 48

B.P. 90/60 T P R 97⁶/86/20 WT 8.7.0

HB 80% R B C 4,690,000 W B C 3,000

DIAGNOSIS & OPERATION PROPOSED — DATE

Gastro-colic fistula — for closure

5 months Abd pain & vomiting.

3 weeks Diarrhoea & foul flatulence

Debilitated — has lost over 3 stone in wt.

DETAILS OF PREOPERATIVE COMPLICATIONS AND PREVIOUS ANÆSTHETIC HISTORY

Dehydrated in spite of I V Saline

Breath Sounds distant.

Gastro-enterostomy 10 years ago

No details of anaesthetic.

DETAILS OF POSTOPERATIVE COMPLICATIONS

Condition Satisfactory.

I V Saline for 24 hours

Oxygen therapy by B.L.B mask for 48 hours — No abdominal distension developed

Some cough & sputum with a few scattered rhonchi audible in the lungs for the first two days after operation.

RESULT

Discharged fit 4 weeks after operation, having gained 16 lbs in wt.

THE COPELAND CHATTERSON PARAMOUNT CARD

PAT NOS 226063 287892 C C 87797 K

SEX (A): M / F

AGE (B): -10 / -20 / -40 / -60 / 61 & OVER

SITE OF OPERATION (K): Brain & Spinal Cord; Mouth Nose & Throat; Thyroid; Other Head & Neck; Intrathoracic; Body Wall; Upper Laparotomy; Lower Laparotomy; Inguinal; G U; Perineal; Extremities

MAJOR OPERATION / MINOR OPERATION

TIME IN HRS (L): -½ / -1 / -2 / 2+

PRE MEDICATION (M): OPIATE / ORAL / RECTAL

PHYSICAL STATE (C): 1 GOOD / 2 FAIR / 3 POOR / 4 SERIOUS / EMERGENCY

PREOPERATIVE COMPLICATIONS (D): INCOMPLETE DATA / RESP MAJOR / RESP MINOR / C V S / C.N.S / G U / GASTRO INTESTINAL / METABOLIC

SPECIAL STUDY (E): ANÆS RECORD OF SPECIAL INTEREST

TECHNIQUES (F): OPEN OR INSUFFLATION / ABSORPTION / SEMI OPEN OR CLOSED / OROTRACHEAL / NASOTRACHEAL

DURING ANÆSTHESIA (G): 1 EMERGENCY / 2 I V THERAPY / 3 C V S DISTURBANCES / 4 RESPIRATORY DISTURBANCES / 5 ADMINISTRATION SATISFACTORY

REFLEXES IN TH WITHOUT COMPS (H)

MAX DEPTH OF MAINTENANCE (J): 0 / 1 / 2 / 3

ANÆSTHETIC AGENTS (N): REGIONAL / SPINAL / I.V. / N_2O / C_3H_6 / ETHER / ETHYL CHLORIDE / $CHCl_3$ / OTHER

SEQUENCE OF ANÆSTHETIC AGENTS

AGENTS USED: ONE / TWO / THREE

POSTOPERATIVE COMPLICATIONS (O): TECHNICAL / RESP MAJOR / RESP MINOR / 1–4 DAYS / .. LATER / C V S FIRST 24 HRS / C V S LATER / C N S / G U / OTHER / NONE OF ABOVE / VOMIT O

CAUSE OF DEATH (U): OTHER CAUSES / EXISTING DISEASE / INFECTION / RESPIRATORY / C V S / ANÆSTHESIA

(T) AUTOPSY PERFORMED

TIME OF DEATH (S): LATER / 4–14 DAYS / 1–3 DAYS / ON TABLE

(R) DIED

(Q) INHALATION THERAPY ADMINISTERED?

(P) TRACHEO BRONCHIAL SUCTION APPLIED

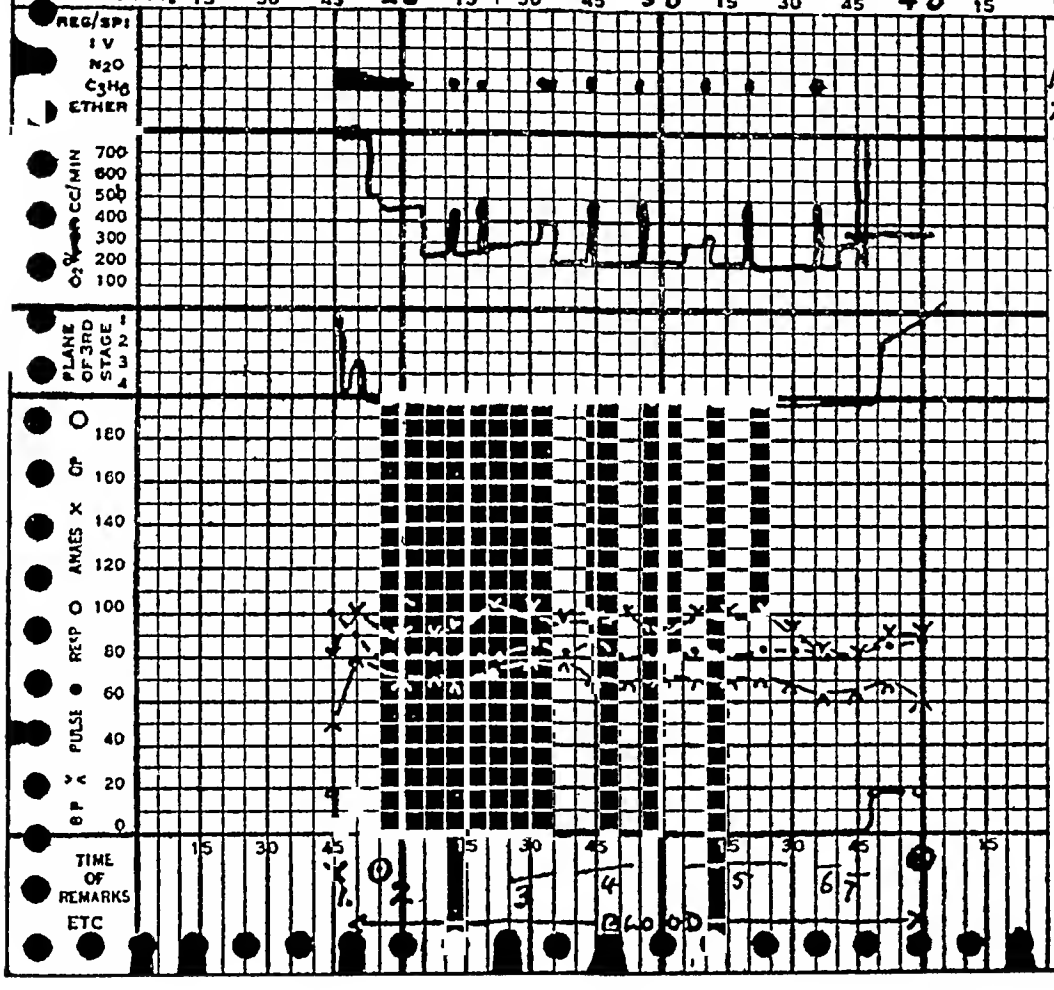
-12 HRS / -24 HRS / 24+ HRS

DATE —

OPERATION PERFOPMED CLOSURE OF GASTRO-JEJUNO-COLIC FISTULA

SUR-GEON

ANAES-THETIST



REMARKS

1. INTUBATION
2. PERITONEUM
3. CLOSING COLON
4. CLOSING STOMACH
5. JEJUNUM CONSTRICTED AT ANASTOMOSIS DIVIDED END TO END ANASTOMOSIS
6. CLOSING HOLE IN TRANS-MESO-COLIC
7. CLOSING PERITONEUM.

ENCIRCLE POSITIVE FACTORS ON BOTH SIDES OF CARD

PREMEDICATION DRUGS & DOSES

OPOIDINE gr 1/3 } 1 hr b.o.
ATROPINE gr 1/100 }

(SATISFACTORY) TOO DEPRESSED APPREHENSIVE

ANAESTHETIC AGENTS

C_3H_6

TECHNIQUES & TYPE OF APPARATUS

CLOSED → ABS. (To & FRO)

(OROTRACHEAL) R L BLIND

(CUFF) PACK UNDER MASK

TECHNICAL DIFFICULTY

1 { MASSIVE HÆMORRHAGE GRAVE OXYGEN WANT
CARDIAC ARREST CONVULSION EXPLOSION

2 (I V THERAPY) BLOOD OIL

3 { ARRHYTHMIA BRADY/TACHYCARDIA
MARKED B P. FALL/RISE SHOCK

4 { RESP. DEPRESSION MOD RESP OBSTRUCT
SEV LARYNG OBSTRUCT EXCESS MUCUS
RETCH VOMIT MUCH COUGH

5 { INDUCTION SATISFACTORY (YES) NO
MAINTENANCE SATISFACTORY. (YES) NO

RECOVERED REFLEXES IN THEATRE (YES) NO

(RETCH) VOMIT EXCIT SEV OBSTRUCT

THE ANÆSTHETIC-RECORD IN USE

It will be apparent that the holes round the sides of the card are arranged in groups with headings marked "A–U" (Fig 1) At the anæsthetist's preoperative visit to the patient positive factors in groups "A–D" are encircled, i e the patient's sex, age, physical state, and any preoperative complications presented The reason for so grading the physical state and details of why a preoperative complication has been encircled must be entered in the appropriate place in the centre of the card together with the other relevant data

Positive factors in groups "E–N" are encircled after the operation has been performed—the requisite data being transferred from the back of the card

Positive factors in "O," and "P" and/or "Q" if positive, are encircled during postoperative visits to the patient and details of any such, together with other relevant comments, must be entered in the centre of the card Attention is, in like manner, given to encircling and recording details of positive factors in "S," "T," and "U" on cards in which "R" is positive (i e the patient having died in hospital)

Reference to the Anæsthetic Record here reproduced will illustrate how the data are collected

The patient was a male (A) His age was 48 and therefore fell in the "–60" group (B) He was suffering from a gastro-colic fistula and on account of his debilitated condition he was graded Physical State 3 (C) In spite of intravenous saline he had definite evidence of dehydration which was his C V S , and only significant, Preoperative Complication (D) No particular Anæsthetic Study was being undertaken, nor did the Anæsthesia Record show any happening of Special Interest (E)

The inhalation technique used was Absorption by the Oro-tracheal route (F), details on the back of the card show that Waters's "to and fro" absorption method was employed after a closed induction, and that a cuff was used on the endo-tracheal tube

Intravenous Therapy—2 pints of blood noted on the back of the card—was administered during operation, and the Anæsthetic Administration was Satisfactory (G) The patient

recovered his Reflexes in the operating Theatre Without Complications (H)

The Maximum Depth of Maintenance was recorded as the 4th plane—reference to the back of the card showing that "controlled respiration" was used almost throughout (J) An Upper Laparotomy was the site of operation, the procedure being a Major Operation (K)—recorded on the back of the card as "Closure of a Gastro-jejuno-colic fistula" The operation took "over 2 hours" to complete (L)

An Opiate (Opoidine gr 1/3 and Atropine gr 1/100, one hour before anæsthesia, having a "satisfactory" effect noted on the back of the card) was the only form of Premedication (M) One Anæsthetic Agent only, to wit Cyclopropane, was used (N)

After operation the administration of intravenous saline was resumed for twenty-four hours A high oxygen atmosphere (Q) was delivered to the patient by means of a B L B mask for forty-eight hours with intent to prevent the postoperative development of abdominal distension—none occurred

The patient developed a Minor Respiratory Complication, the time of onset of which occurred within four days of operation (O)—some cough and sputum with a few scattered rhonchi audible in the lungs for the first two postoperative days Otherwise the patient's convalescence was uneventful, and he was discharged fit four weeks after operation, having gained 16 lb in weight

Some may say that the anæsthetist cannot pay attention to his patient and keep a chart at the same time In point of fact the observations made in keeping the record necessitate a very close watch being kept on the patient As the operation proceeds these observations take shape as a graph, and the anæsthetist soon realizes that certain phenomena produce typical reactions on the part of the patient, for example, an intrathoracic tumour was diagnosed by the anæsthetist from his chart as a goitre some twenty minutes before the surgeon arrived at the same conclusion Again, just as a temperature chart is much more illuminating than are a series of figures in a report book, so a chart showing the trend of blood-pressure or other changes helps towards a quicker and more

accurate appreciation of the patient's condition and so an earlier opportunity to correct any undesirable state [4] Besides focusing the anæsthetist's attention upon the patient and how he is affected by what is done to him, as Waters stresses, records also serve as a basis for later leisurely discussion on procedures and results, that is, they are the basis for all teaching and all improvements in practice Without well-kept records we are deprived of a basis for discussion, comparison and conclusion, and are left dependent upon memory and personal opinion as a foundation for instruction and for progress [5]

How to keep such a record as that described is not difficult to understand, but in order that there may be uniformity of usage amongst anæsthetists working in different places suggestions for the standardization of record-keeping are set out below

THE STANDARDIZATION OF RECORD-KEEPING

Group "A" is self-explanatory The first hole in group "B" covers patients of 10 years old or less, the second hole those whose ages lie between 11–20 inclusive, and so on

Physical State

The physical state of the patient (group "C") must be judged entirely on his physical condition as a result of physical, X-ray, and laboratory examinations This practice will result in much greater accuracy and uniformity in the grading of patients than would be the case were an attempt made to take into consideration as well other factors such as the severity of the proposed operation, the experience of the surgeon or the anæsthetist, the attention to the postoperative care, etc For instance, were these variable factors allowed to influence the grading of the patient the same patient might be considered a fair risk for a minor operation but a poor risk for a major surgical intervention Again, the anæsthetist might consider the same patient about to undergo, say, a partial gastrectomy as representing a different risk depending upon whether an expert or inexperienced team was to

Although their presence should be recorded in the centre of the card valvular disease or hyperpiesia, without signs of failure or cardiac enlargement, are regarded as of little significance.

C N S This factor should be encircled only if the patient is irrational, unco-operative, or comatose, or when there is present an increased intracranial pressure, or nerve palsies likely to predispose the patient to respiratory or other sequelae

G U The presence of low renal function, suppression, acute retention, or severe infections of the tract indicate the encirclement of this factor

Gastro-intestinal This factor should be encircled only if the patient has a perforated or acutely infected viscus (hollow or solid), gross abdominal distension, or a major degree of intestinal obstruction

Metabolic The presence of jaundice or poor liver function, definite alkalosis or acidosis, or marked endocrine disfunction, such as thyrotoxicosis, *uncontrolled* diabetes, gross obesity, etc , indicates the encirclement of this factor

Heading "E"

The "Special Study" hole is encircled when a special investigation is being made into any particular problem, e g a particular type of operation, a new anæsthetic agent or method, the study, say, of the occurrence of arrhythmias during anæsthesia, etc

The "Special Interest" hole is encircled when the anæsthetic chart shows the presence of abnormal physical signs or unusual respiratory, c v s , or other changes to which reference may be required at some subsequent date—e g for teaching purposes

Techniques

Three holes are provided to show different inhalation techniques in group "F" If the technique used for induction differs from that used for maintenance both positive factors *can* be encircled Those with little secretarial assistance, how-

ever, are advised to encircle only the technique used for maintenance—or that for induction if this period was the longer Full details of the techniques used are written on the back of the card together with the type of apparatus employed, e g to and fro, or circle absorber, etc

The fact that endotracheal anæsthesia was used is shown by encircling in addition the hole appropriate to the route employed—either Orotracheal or Nasotracheal The encirclement of positive factors on the front of the card provides further details about the intubation to which reference may be desirable during the patient's convalescence or at some later date There is recorded whether the intubation was accomplished "Blind" without direct vision laryngoscopy, whether the right or left nostril was used, whether a cuffed tube or a throat pack was employed, or whether the tube was used merely as a laryngeal airway under the mask, and finally whether intubation was technically difficult and a note if any trauma was inflicted

During Anæsthesia

The five numbered subdivisions in Section "G" refer to the similarly numbered groups printed on the right side of the back of the card (Fig 2) positive factors in which would be encircled during the administration

1 *Emergency* is encircled if either a Massive Hæmorrhage, Grave Oxygen Want, Cardiac Arrest, a Convulsion, or an Explosion occurred during anæsthesia On sorting the cards it will not be possible to discover the incidence of *each individual type* of emergency by needling The total number of cards, however, will be small—although the group is interesting and important—and it will take little time, if complete details are required, to refer to the back of each card and so find the actual emergency encircled with full details of its occurrence and treatment

2 *I V Therapy* refers to the same heading on the back of the card against which, if positive, must be recorded the type and quantity of fluid or drug administered The time of its administration should be marked, like that of other interesting happenings, at the foot of the chart

3 *C V S Disturbances* in like manner is encircled if Arrhythmia, Bradycardia or Tachycardia, a Marked Fall or Rise in Blood-Pressure, or Shock was observed and ringed during the administration

4 *Respiratory Disturbances* It will be observed that "Retch" and "Vomit" are included in this group on the back of the card The possible aspiration of foreign matter and hence a predisposition to postoperative respiratory complications warrants their inclusion under this heading

Any other factor which disturbs the smooth course of anæsthesia—although not specifically set out here—should be noted in the relevant group, e g blood or other foreign body in the respiratory tract would be noted in the Respiratory Disturbances Group, etc.

5 *Administration Satisfactory* is encircled provided both induction and maintenance have satisfied both surgeon and anæsthetist Space is left on the back of the card for the anæsthetist to state why either was not satisfactory For example, below Induction the comment "Struggling" or "Respiratory Obstruction" might perhaps be called for, below Maintenance perhaps the comment "Muscular Rigidity" or "Spinal Block Too Low (or Failed)"

Headings "H" and "J"

Heading "H" should only be encircled if the back of the card records that the patient recovered his reflexes in the operating theatre *without* retching, vomiting, excitement, severe respiratory obstruction, or any other unspecified complication

Heading "J" has five holes "O" represents Analgesia only, while holes 1–4 denote which was the deepest of Guedel's planes of the 3rd stage used for maintenance—as recorded on the chart on the back of the card If a patient is pushed momentarily at the close of a quick induction down, say, into the 4th plane for intubation and subsequently maintained in, say, the 2nd plane, throughout the operation, hole "2" should be encircled In all other circumstances the deepest plane which the patient ever entered is to be encircled

Site of Operation

Section "K" is a double one since besides encircling the site of operation the anæsthetist must also encircle whether the operation was a "Major" or a "Minor" intervention

The proposed operation and date thereof is written in the space allotted in the centre of the front of the card beforehand, and the operation actually performed together with the date and the surgeon's and anæsthetist's names are recorded on the back of the card Changes of the patient's posture are to be noted at the foot of the chart

The operation sites themselves are almost self-explanatory "Brain and Spinal Cord" includes operations on the spine "Mouth, Nose, and Throat" are grouped together as procedures during which—unless care is exercised—blood may be aspirated into the air passages "Other Head and Neck" includes all operations on these regions not included in the three foregoing sites, operations on the eye and ear will therefore come into this fourth site

"Body Wall" includes operations on the chest wall such as amputation of breast or thoracoplasty as well as all operations on the abdominal wall which do not involve the peritoneum, the genito-urinary tract, or the inguinal region

An operation, such as an abdomino-perineal excision of rectum, involving two operation sites would be encircled as a "Lower Laparotomy" and also as a "Perineal"—and of course a "Major"—operation

A minor operation, strictly defined, is one producing no constitutional disturbance and carrying a negligible mortality and morbidity For statistical purposes, however, an operation is to be considered "major" or "minor" in relation to the operative site involved Thus, for example, the removal of a non-toxic, non-obstructive adenoma of the thyroid gland will be considered a "minor" procedure, whereas the removal of a toxic or obstructive gland would constitute a "major" operation Any laparotomy is to be considered a "major" intervention and likewise any surgical interference involving the lung or mediastinum

Section "L" refers to the actual operating time and not to the duration of the anæsthetic administration The com-

mencement and the termination of both the anæsthetic administration and the operation are to be marked at the foot of the chart on the back of the card, so that the duration of induction can be readily ascertained

The Anæsthetic

Three holes are devoted to Premedication (M) "Opiate" includes morphine or any opium-derivative "Oral" includes all sedative drugs administered by mouth "Rectal" covers all sedative or basal hypnotic drugs administered by that route More than one factor may have to be encircled The drugs and doses, the time they were given and the effect they produced are recorded on the back of the card in the space allotted

Section "N" is a composite group "One," "Two," or "Three" are encircled according to the number of anæsthetic agents used It will be observed that opposite each of the anæsthetic agents (or methods) there are two holes instead of one as in the other sections The inner row of holes is marked "Principal" and the outer row "Secondary" The purpose of the two rows of holes requires explanation

The inner hole is encircled if that particular agent was the "principal" one employed When the card is punched later this slot is made deeply to open both inner and outer holes An agent used either as an adjuvant or just for induction purposes is denoted as a "Secondary" agent by the encirclement of only the appropriate outer hole At punching this slot will be made only into the outer hole leaving the inner hole still intact The anæsthetic agents used are inscribed at operation on the back of the card in the space allotted for this purpose, and the time of their introduction is marked on the chart itself together with the amount of oxygen added From these data are determined the principal agent used and any secondary agents In the event of more than three anæsthetic agents being employed for any case, after determining the principal agent the two most important of the remaining agents are selected as the secondary agents Therefore, on any card one principal agent, and one only, is always en-

circled and two, one, or no secondary agents are also ringed as indicated by the findings on the back of the card

An example will show how this composite group provides useful information Consider two patients who had each been exposed to two anæsthetic agents, say, an intravenous one and nitrous oxide, the one patient receiving the intravenous anæsthetic for one hour and then nitrous oxide for ten minutes, whereas the other patient only received sufficient intravenous anæsthetic to abolish consciousness and thereafter one hour's nitrous oxide anæsthesia Although both patients received the same agents their anæsthesias cannot usefully be regarded alike and the difference would be emphasized on the record card as follows —In both instances the "Two agents used" hole would be encircled, but in the first instance I V would be encircled as the principal agent (requiring a deep slot later) and N_2O as the secondary (only the outer hole being slotted later), whereas in the second instance I V would be ringed as the secondary agent (and only the outer hole slotted) and N_2O as the principal (a deep slot to open both inner and outer holes being made when punching is done)

When sorting, the number of occasions on which a particular agent has been used—regardless as to whether alone or in combination (either as principal or secondary)—can be found by first needling the appropriate *outer* hole Or again, by first needling the appropriate inner hole the number of times that particular agent has figured as the principal anæsthetic agent can be determined, then by needling the outer hole the number of times the same agent has been used as a secondary agent can be found Or finally, after separating a pack of cards into three piles by first needling the number of agents used, straight single agents and the various combinations of principal and secondary agents can be worked out In such fashion whatever information is required about the anæsthetic agents can be brought to light

The anæsthetic agent designated by the word "Other" is encircled when some unspecified agent such as Ethylene, Trichlorethylene, Vinethene, etc , has been used

Postoperative Complications

This group (O) is divided into subdivisions much like those in the preoperative complication group (D) A factor already present preoperatively should not be encircled as a postoperative complication unless the existing condition has been aggravated Besides encircling the positive factors, details of any such together with other relevant comments on the patient's postoperative course and condition must be entered in the centre of the card in the space allotted

Technical This hole is encircled whenever a complication is directly due to a faulty anæsthetic technique The following will serve as examples trauma to lips, teeth, tongue or air passages resulting from the use of artificial airways, etc , conjunctivitis, corneal abrasions, or burns of the skin from the spilling of volatile anæsthetic agents, sepsis due to injections for Regional Anæsthesia Thrombosis of the vein or local complications following the use of intravenous anæsthesia would indicate the encirclement of this hole, whereas thrombosis elsewhere would call for the ringing of the appropriate C V S complication hole Nervous sequelæ following spinal anæsthesia should be entered against C N S complications, and likewise an aspiration pneumonia against Respiratory complications Although both these may be directly due to a faulty anæsthetic technique it will be found more helpful to allocate them as indicated

Respiratory The Major and Minor complications are similar to those enumerated under Section (D), with the exception of pulmonary tuberculosis, bronchiectasis, intrathoracic tumour, oral sepsis, rhinitis, bronchial asthma and emphysema A minor respiratory complication should not be encircled postoperatively when a major respiratory complication has been recorded preoperatively

The "1–4 Days" or the "Later" hole should also be encircled depending upon the time of onset of the respiratory complication after operation

C V S Signs of cardiac failure, persistent abnormal rhythms, serious embolus or thrombosis (except of the vein employed for intravenous anæsthesia), or peripheral circulatory failure rank as cardiovascular complications.

Which of the two holes provided should in such an event be encircled would depend on whether the time of onset was within twenty-four hours of operation or later

C N S In addition to the factors enumerated under this heading in Section "D" the presence of severe headache or nervous sequelæ following anæsthesia would indicate the encirclement of this hole

G U The encircling of this hole is indicated by the occurrence of any of the complications, except sepsis, enumerated under this heading in Section "D"

Other The development of jaundice, failure of liver function, or other unspecified major complication, indicates the encirclement of this hole

None of Above This hole should be slotted when none of the above-mentioned complications were presented During sorting the needling of this hole furnishes a ready method of finding the patients who developed no postoperative complications with the possible exception of vomiting One further needling through the "Vomit O" hole will sort out the patients who had no complications whatever

Vomit Encirclement of the appropriate hole indicates whether no nausea or vomiting occurred, or whether nausea and/or vomiting lasted for less than twelve, less than twenty-four, or for more than twenty-four hours

The Last Side of the Card

Tracheo-bronchial Suction "P" This factor is encircled if the patient was intubated during the postoperative period and secretions aspirated from the tracheo-bronchial tree [8]

Inhalation Therapy "Q" This factor is encircled if oxygen, carbon-dioxide, or helium was administered to the patient during the postoperative period

Heading "R" This factor is encircled if the patient died before his discharge from hospital and the time of his death is shown by the encirclement of the appropriate hole in *Section "S"*

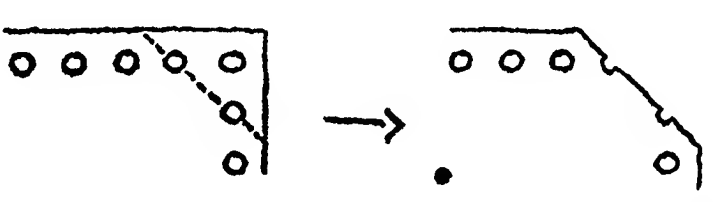
Heading "T" When this factor is encircled, it denotes that the cause of death was confirmed by autopsy

Cause of Death "U" Six holes are devoted to this sec-

tion "Anæsthesia" should be encircled not only when a patient dies during the induction of anæsthesia before the operation is commenced but also whenever direct responsibility can be attributed to the anæsthetic administration—e g death due to asphyxia "Infection" should be encircled if a patient dies of peritonitis or an infective process anywhere in the body with the exception of the respiratory tract Death from secondary hæmorrhage, since almost invariably due to sepsis, would indicate the ringing of the "Infection" hole, whereas death from primary or reactionary hæmorrhage would indicate encirclement of the "C V S" hole

When all positive factors have been encircled and the relevant details filled in, the appropriate holes are slotted with punch or scissors Then, and not till then, the corner marked with the diagonal line is snipped off and the card filed away

In the ordinary way the corner should be cut off along the line so that the "one from the corner" holes are opened, thus



When, however, a patient has had two or more anæsthetic administrations and therefore has two or more record cards referring to the *same* stay in hospital, the fact may be shown by cutting off only the corner hole of each card, thus

Such cards can then be separated by needling either of the "one from the corner" holes which will now be left intact For example, if a patient "burst his abdomen" after a laparotomy and subsequently died after its resuture, he would be recorded on each record card as having died The desirability of being able to sort out the multiple anæsthesia

cases is necessary from the statistical point of view since it is obvious that one patient should only be recorded as having died once and yet the first operation *had* a fatal outcome

Summary

The record card described provides facilities for collecting and recording all relevant anæsthetic data as well as a method of assessing results statistically This is all accomplished on the same card without having recourse to the use of a code book or sorting machine In view of its simplicity and directness the method is particularly recommended to those who plan to file records for the first time.

I am much indebted to Col B C Leech, R C A M C , and to Lieut-Col R M Tovell, U S M C , for many helpful suggestions during its preparation The card has been designed to cover both military and civilian needs, and it is hoped to try and use the record in selected hospitals in the English, Canadian and United States Armies as well as in civilian practice The cards are made by the Copeland-Chatterson Company and can be obtained from Messrs A Charles King Ltd , *27* Devonshire Street, London, W 1

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THE ANÆSTHETIC RECORD

BY

PHILIP AYRE, M R C S (Eng), L R C P (Lond)
Newcastle-upon-Tyne ,

MOST hospitals and surgical clinics to-day use an anæsthetic record or chart for recording the condition of the patient during the progress of the operation, and afterwards in the ward For some years the writer has made a hobby of collecting charts from various clinics, and it is obvious that considerable divergence of opinion exists with regard to the composition of an anæsthetic chart Some anæsthetists prefer a simple form of chart consisting mainly of a graphic record of blood-pressure, pulse, and respiration, others favour a more elaborate record involving the use of codes and symbols, with provision for innumerable pre-operative and post-operative complications, and an operation chart which includes everything from the Basal Metabolic Rate to the anæsthetist's fee !

In drawing up an anæsthetic chart, a great deal depends upon the conditions under which the anæsthetist has to work The punch card system[1] practised in America, and described in these pages, is too elaborate for use in this country, at any rate until each hospital has its own Department of Anæsthesia, staffed by whole-time specialist anæsthetists with technical and other facilities at present conspicuous by their absence In this country the harassed anæsthetist not only has to cope with wartime difficulties, but often wastes a lot of time and energy in travelling from one hospital to another Even before the war, the present writer sometimes visited as many as three or four hospitals in one day, and it would need a superman to keep complete records in such circumstances

The present anæsthetic record and operation chart has been designed with strict regard to practical considerations, and represents an attempt to provide the maximum of essential

WARD C 3&4 **NEWCASTLE GENERAL HOSPITAL** DATE DEC. 9TH, 1942

ANÆSTHETIC RECORD

NAME R— W— . AGE 27 SEX M. DIAGNOSIS SCIATICA (L.)

OPERATION LAMINECTOMY AND REMOVAL OF THICKENED LIG SUBFLAVA. SURGEON MR ROWBOTHAM.

SUMMARY OF PRESENT ILLNESS

SCIATICA ON LEFT SIDE FOR 12 MONTHS.

PREVIOUS ANÆSTHETICS

NONE.

GENERAL CONDITION

(Good) Fair Bad Moribund

Temp 97° Pulse 78 Resp 18

B P Syst 125 Diast. 70

Urine. S G 1014 Acid/Alk.

Sugar — Acetone —

Albumin — —

Hæmoglobin — Blood Urea —

Appearance HEALTHY.

Physique GOOD. Weight NORMAL.

Mental State PLACID.

Blood Group I II III (IV) — AB A B O

Cardio Vascular System	Respiratory System
N.A.D.	N.A.D
Cardiac Decompensation (Nil) 1° 2° 3°	Cough — Sputum — Vital Capacity —

PREMEDICATION Omnopon gr ⅓ & atropine gr 1/100

Time given 1.30 p.m. Effect SLIGHT

Basal Hypnotic	Induction	Maintenance	Technique
PENTOTHAL SODIUM 6 c.c.	N_2O + O_2 + ETHER	N_2O + O_2 + TRILENE (5 drachms)	PARTIAL REBREATHING
~~Rectal~~ Intravenous	Smooth ~~Struggling~~		Intubation ORAL

GENERAL LOCAL REGIONAL SPINAL

Began 2.30 p.m. Ended 6.10 p.m.

Condition of Patient On leaving Theatre. GOOD. OPENED EYES.

ANÆSTHETIST DR AYRE.

information concerning the patient with the minimum of clerical labour It is intended for routine use in hospital, including maxillo-facial, thoracic, neuro-surgical and other "special" clinics It is compact ($9\frac{1}{2}$ inches by 8 inches) and contains sections for recording the pre-operative condition of the patient, anæsthetic agents and technique, a four-hour operation chart and a space for recording post-operative progress Except for a few relatively common post-anæsthetic complications, long lists of hypothetical pathological conditions have been avoided In the writer's opinion, such lists take up space which might be used to better advantage, and a summary of abnormal clinical findings with a short account of the relevant medical history conveys a far clearer picture, when reviewed at a later date If it is desired to tabulate and classify the results of anæsthesia for hospital statistics, this can be done separately by means of the punch card or other system of classification, preferably by a specially trained clerical staff The original record should then be filed with the other case records, or a micro-photograph may be taken in order to conserve storage space

When filling in the anæsthetic record, it should be remembered that it is not the duty of the anæsthetist to make a complete clinical record of the case, and only those pathological conditions directly affecting the anæsthesia need be considered in detail Broadly speaking, the special points which concern the anæsthetist are as follows

(1) Anatomical conditions obstructing free respiration, e g nasal obstruction, adenoids and tonsils, enlargement of the thyroid gland, œdema of the glottis

(2) Heart disease with symptoms of myocardial decompensation, especially when associated with mitral stenosis or aortic incompetence

(3) Reduced vital capacity due to pulmonary disease, e g pneumothorax, empyema, bronchiectasis, lung abscess, tuberculosis, emphysema and other lung affections

(4) Conditions interfering with the transport of oxygen by the blood, e g anæmia, blood diseases, hæmorrhage or shock

(5) Acidosis and ketosis due to starvation, diabetes or nephritis

(6) Alkalosis and dehydration resulting from prolonged vomiting, e g acute intestinal obstrúction, pyloric stenosis, cerebal tumour

(7) Toxæmia or septicæmia complicating acute surgical conditions, e g cellulitis, osteomyelitis, peritonitis

(8) Lowered vitality due to malignant cachexia, chronic sepsis or general debility

(9) Impairment of hepatic or renal function

(10) Injury or disease of the central nervous system

Theoretically the basal metabolic rate should be included in the foregoing list, but the technical difficulties render this investigation impracticable except in special cases

On many anæsthetic charts the anæsthetic or operative "risk" is indicated by symbols or letters, such as A, B, C, D, DD, and so on In a recent paper by Adams and Lundy[2] a classification of operative risk is suggested on the following lines "Grade I, patients in such good physical condition that they will probably tolerate any anæsthetic agent well, grade 2, cases of so-called average risk, in which the risk of the operation is greater than the risk of the anæsthesia, grade 3, patients for whom the anæsthetic agent must be selected with care, since, owing to pathological conditions, the risk of the anæsthesia is as great or greater than the risk of the operation, and grade 4, patients who are in such serious physical condition that the use of any anæsthetic agent is dangerous" In the writer's chart the words "good," "fair," "bad" and "moribund" correspond to these four categories

The rest of the anæsthetic record needs little comment In order to avoid overcrowding the operation chart, separate spaces have been provided for recording the anæsthetic agents used and the depth of surgical anæsthesia A line drawn at the appropriate time interval represents the duration of each anæsthetic agent administered during the operation, above the lines figures may be inserted indicating the minute volume in litres, or the percentage in the gaseous mixture A blank space has been left for ether, trichlorethylene, chloroform or other supplementary anæsthetic agent For charting the depth of anæsthesia figures are written representing the various planes of the third stage according

to the classification of Guedel, or a line may be drawn descending nearer to the base line as the anæsthesia deepens

In addition to the functions already mentioned, the anæsthetic record plays an important part in the practical instruction of medical students the latter should preferably work in pairs, one administering the anæsthetic and the other filling in the chart In this way students can see for themselves the physiological effects of anæsthetic overdose, respiratory obstruction, shock, hæmorrhage and other complications arising during the course of the operation, and learn to appreciate the necessity for looking after the general condition of the patient while administering the anæsthetic

In conclusion, it is only fair to mention that in designing the foregoing anæsthetic record considerable reference has been made to records and charts used in other hospitals It has been printed for the Newcastle General Hospital by Messrs Andrew Reid and Co , Newcastle-upon-Tyne

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ABSTRACTS

"Fate of procaine after subarachnoid injection" GOLDBERG, KOSTER and WARSHAW in *Archive of Surgery*, January, 1943

THE authors developed a technique which enabled them to trace the course of the drug and determine what changes it underwent after insertion into the spinal canal Their conclusions were

(1) Procaine remains unchanged while within the subarachnoid space The fall in concentration which is responsible for the wearing off of anæsthesia is due to vascular absorption

(2) Once in the blood-stream procaine is rapidly hydrolysed (detoxified by an enzyme)

(3) There is also an enzyme which acelytates the free amino group

(4) At no time is there any appreciable trace of procaine in the blood, hence the cause of various "toxic" effects which have been attributed to this must be sought elsewhere

(5) The products of detoxication leave the blood-stream rapidly until equilibrium is approached between the blood and all the other tissues

(6) Nearly all the injected procaine is excreted in the urine in the form of products of detoxication Detoxication takes place in the liver Gravitational displacement of the injected solution is negligible

"Two Thousand cases of Nupercaine Spinal Anæsthesia" R S VERSTER, F R C S (Edin) *South African Medical Journal*, March 27, 1943, p 89

IN a series of 2,000 operations under spinal anæsthesia there was one death The hypobasic solution Nupercaine 1/1500 was administered according to the Howard-Jones technique The level of anæsthesia was controlled by the amount of Nupercaine solution injected into the C S F

REVIEW

"Regional Anæsthesia for Intra Abdominal Surgery" By NORMAN R JAMES Published by Messrs J & A Churchill Ltd , London p 240 Price 6*s*

REGIONAL anæsthesia has not been popular in this country in the past but the publication of this book may awaken renewed interest in the subject

Dr Norman James is of the opinion that regional anæsthesia for intra-abdominal operations is the most satisfactory of all present forms of anæsthesia for patient, surgeon and anæsthetist and believes it is neither difficult to learn nor dangerous in the hands of the beginner

The general technique, which may be modified for certain operations and for which very little special equipment is necessary, consists of blocking the lower seven thoracic nerves on both sides and performing bi-lateral posterior splanchnic block Anethaine or amethecaine hydrochloride though more toxic than cocaine or procaine when used in a 1/1000 solution for the thoracic block and a 1/2000 solution for the splanchnic block, produce anæsthesia which lasts over 3 hours, and seldom produce toxic symptoms in a patient if overdosage is avoided

If supplementary narcosis is considered advisable it is administered either in the form of a light general anæsthetic or a strong hypnotic—large doses of morphia or Omnopon given intravenously have proved satisfactory Complete relaxation of the abdominal muscles is produced by the thoracic block, and operative shock reduced to a minimum by the bi-lateral splanchnic block, performed according to the method of Kappis It is of interest to note that in a severely shocked patient when the blood-pressure is low the fall of blood-pressure which always follows splanchnic block does not seem to affect the general condition of the patient Oxygen therapy, for which a B L B mask is used, is of immense value in these patients as well as in those showing

toxic reactions to anethaine or in respiratory depression from other causes

There are many advantages in regional anæsthesia, notably the complete abdominal muscular relaxation, satisfactory condition of the patient, both during and after operation, and the reduction of shock to a minimum It can be used in all non-emergency and emergency intra-abdominal operations, including war casualties

Dr James has written a clear account of this technique and its many advantages, but has not discussed the disadvantages or made mention of any contra indications The fall of blood-pressure following splanchnic block has been considered a disadvantage by many in the past, and fatal results are not unknown

In patients suffering from penetrating wounds of the abdomen, which occur frequently in war casualties, it is often impossible and even dangerous to move them into a position suitable for performing thoracic or splanchnic blocks This point has not been considered by the author when recommending this type of patient as eminently suitable for regional anæsthesia

The present effective methods of anti-shock treatment such as large quantities of plasma, blood, etc , given intravenously, make general anæsthesia safe in these patients if reasonable skill is used, and it is not unreasonable to assume in the light of recent experience, that a patient who is fit for an operation under a local anæsthetic will stand a general anæsthetic equally well

The time factor in regional anæsthesia may also be of importance in these days when staff is limited, the practice of leaving a shocked patient, whether under a regional or general anæsthetic, to the care of an inexperienced person, is not devoid of serious risk

Dr James has made regional anæsthesia sound, safe, easy and reliable, in fact the ideal anæsthetic for intra-abdominal operations When further data are available opinions may differ on this subject, but it may prove to be a definite advance in modern anæsthetic methods

CORRESPONDENCE

Anæsthesia and the Subconscious Mind

DEAR SIR—On reading Dr Hadfield's article in the January 1943 issue of the *British Journal of Anæsthesia* many thoughts came into my mind and from these I jotted down the following, which might be of interest

Among what might be termed the permanent urges of man are the will to live and the attempt to understand life From time to time these are subordinated to more passionate desires which are largely of a temporary nature Thoughts may be repressed into the subconsciousness for many reasons but there are two reasons which taken widely include all other These are, firstly, that the subject is too awful to contemplate, or, secondly, that the mind fails to find any chance of success and gives up the unequal struggle just as a fourth form schoolboy would have to give up a problem in integral calculus

When the subconscious mind asserts itself because the conscious or "controlled" mind has been eliminated these questions are apt to come forward Prevailing emotions suppressed before anæsthesia may arise in the recovery state, the slobbering youth may make love, a man may weep and say he wished he had treated his wife better I had one patient who, on coming round from nitrous oxide, stamped his foot against the footpiece of the chair, seized the arms, yelled, and finally relaxed, saying "I can't hold the b—— thing" On recovery he told us he had been worried for weeks because a speed-recorder had been fitted to his 10-ton lorry so that the tale would be told when he returned Those who have not such present worries may have their minds engaged by what we have termed the more permanent urges

When working with the late S R Wilson and taking nitrous oxide for experimental purposes I often, if not usually, awoke to see the "solution of life" slip from my mind and the immediate reaction was to seize the machine

and give myself some more to recapture this priceless solution before it was too late This is a most dangerous turn of mind S R W was greatly interested in phenomena of all kinds and he was certain that he was on the verge of a great discovery He wrote hundreds of sheets of paper—subjective symptoms and thoughts jotted down as he became influenced by nitrous oxide Twice when I was in attendance we nearly came to blows and once he accused me of having "frustrated him from making the most important discovery of life" He finally killed himself with nitrous oxide

The only constant recording through all "S R 's" papers was Xanthropy in the early stages

Dr Hadfield's patient referred to the revolving and advancing retreating disc—an optical effect I myself discovered the solution to life and infinity under nitrous oxide It consisted of a nucleus of light—a star—which advanced or enlarged, threw off its foremost portions which immediately divided by equal fission into two and these pieces—somehow representing our mortal selves—shot off into space towards me and past my ears to disappear into nothing When I realized that infinity, which as a student I wrote so often of, was nothing more or less than this endless amœba-like fission, I roared with laughter I heard the laughter echo from cavern to cavern The light went out, there was deathly silence, for the fraction of a second I was afraid The dentist looked at me with a very puzzled expression

I think there is little to be gained in trying to capture these subconscious and fleeting thoughts or impulses and as I have remarked I know from my own experience that it is dangerous to allow oneself to be led on in this hopeless quest The frequency of the recording of some optical phenomenon under nitrous oxide is a reminder that blindness occurred in several of the cases of asphyxia recorded by Colville

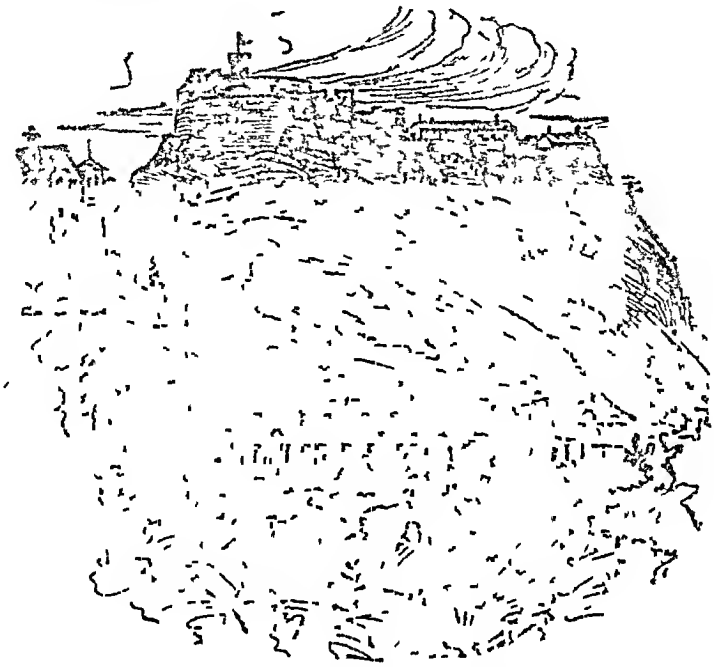
The more puzzling dream is the prophetic one I was giving gas one Saturday afternoon to a man who regretted missing the football match and as he was coming round he shouted "goal" He was very excited and told us that the 'Cobblers" Northampton Third Division football team,

had beaten Huddersfield, the League champions in the "cup" This was 2 0 p m The match was concluded later as prophesied by my patient, complete with the names of those who scored goals

Yours etc ,

F F WADDY

HISTORIC EDINBURGH



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British Journal of Anæsthesia

Editor

JOSEPH BLOMFIELD, OBE, MD (CANTAB)

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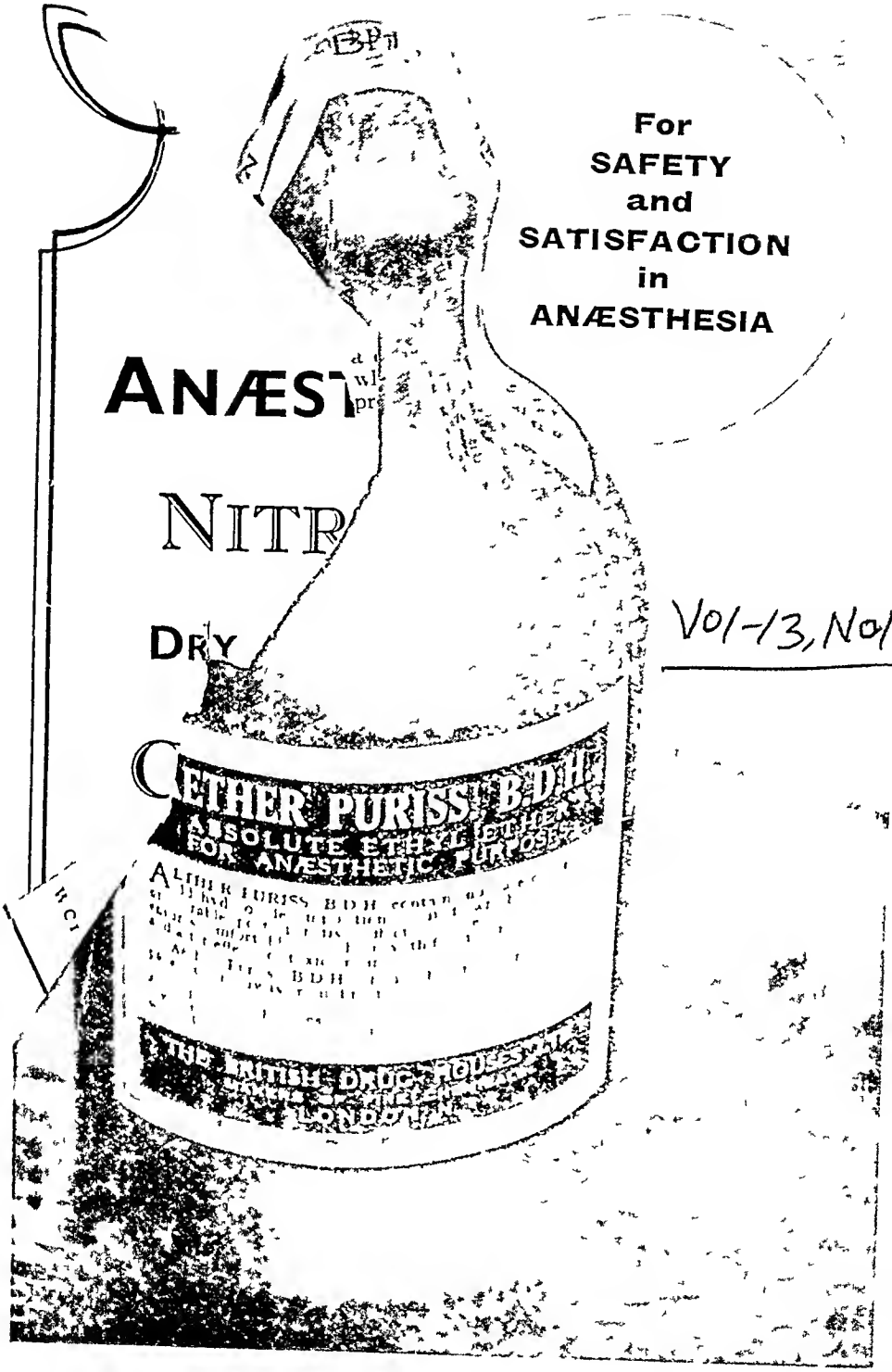

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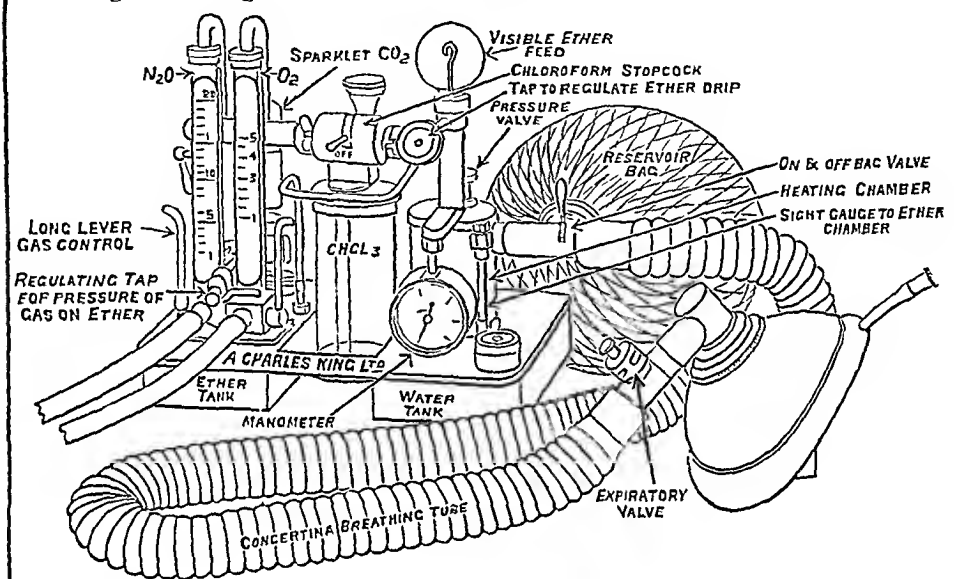

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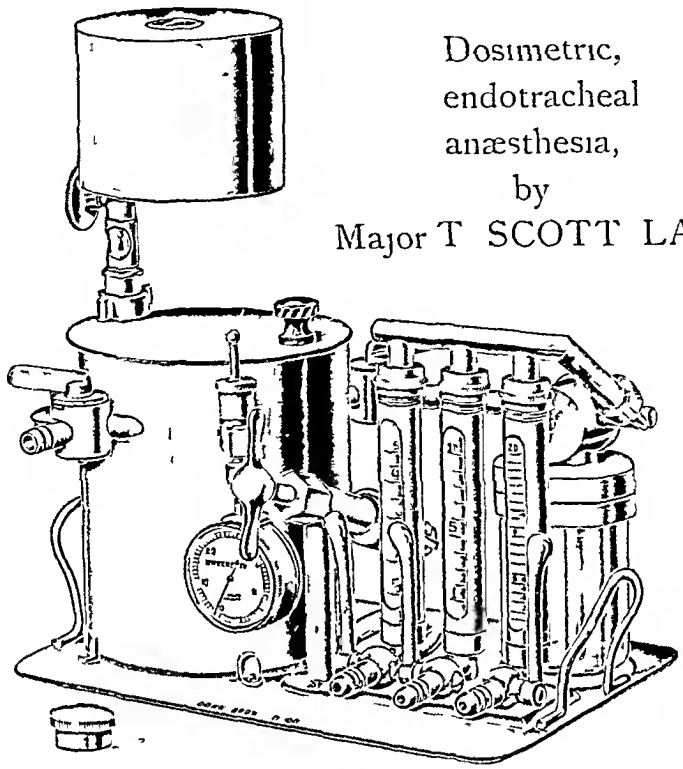

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British Journal of Anæsthesia

Vol. XIII No 1 October, 1935

EDITORIAL.

DISQUIETING reflections affect the minds of many after such a tragedy as the death of our lamented colleague, Howard Jones Must there not be something radically wrong, they ask, in the social and economic system under which we work, if it not only tolerates, but even appears to be the occasion of a catastrophe so distressing? Is there, we wonder, any other walk in life in which a man can be so great a success, and meet so disastrous an end? By what injustice of affairs does it come about that one who has not squandered his means, his energies, or his time, one who has done distinguished and accepted work in his profession, is yet brought to the dread level of self-destruction?

It is easy to call to mind men who have achieved great professional success and yet have finished in pauperdom They may be found in the history of every profession Theirs, however, is a very different story In these instances there is always to be found an explanation of the disaster which is entirely absent from the tale of Howard Jones There has been in these other examples extravagance, or thriftlessness, or dissipation, or domestic misery

None of these things assisted the financial want which destroyed the anæsthetist Many have before now asserted the unjust and inadequate rewards which are meted out to much of our work Never before has this iniquity had so striking or so terrible a demonstration It may be that some such a catastrophe was necessary before public opinion could be aroused, and before men could be brought to realise that many anæsthetists do a vast amount of work in conditions which are unfair and for remuneration which is quite inadequate or actually non-existent It may be that —and let us hope that it will be—this death was not in vain, and that by it Howard Jones will have helped his fellows even as he was always ready to help them in his life

THE SECOND EMBLEY MEMORIAL LECTURE DELIVERED AT MELBOURNE UNIVERSITY

By Z MENNELL, M B (Lond), D A (R C P & S., Eng)

Senior Anæsthetist and Lecturer on Anæsthetics, St Thomas's Hospital, Senior Anæsthetist, National Hospital, Queen Square, Past President, Section of Anæsthetics, Royal Society of Medicine, Treasurer, Association of Anæsthetists of Great Britain and Ireland

FROM time immemorial there has always been a very natural custom of commemorating the passing of the great Emperors and kings, great soldiers and sailors, explorers, statesmen, in fact men and women of outstanding merit in any sphere of life, are those thus honoured

There has always been a veneration for the dead, usually due to the narrow perspective of family affection and intimate knowledge of the life that has passed, but this veneration does not persist in this mundane world for any length of time in the absence of outstanding greatness or achievement attached to those lives keeping their memory fresh Millions of statues and tombstones are scattered about the world to the memory of lives that have gone and are forgotten lives which seemed worthy of the expenditure of large sums of money by friends and relations in pathetic attempts to prove their dead worthy of a niche in the temple of Fame The statue tends to lose its original significance, and its merits in after ages tends to be based upon its artistic value rather than upon the memory of the individual it is supposed to commemorate Lumps of marble and bronze are static scholarship and progress are dynamic

The relief of pain is one of the greatest boons to mankind —such is anæsthesia, and when a pioneer in this subject died it was this natural desire of his fellows to commemorate his work in some lasting manner Such a pioneer was Edward Henry Embley, whose memory we are here to honour We have to consider how the seed he sowed,

which had only to become a small plant when he died, has grown in the last eleven years

The death of such a man causes an immediate shock which seems irreparable at the time, but Nature is kind, and in the passage of years it is possible to look back with an unprejudiced mind, and to form a balanced estimate of the value of the work he has done

It was the wish of Embley's colleagues and friends to perpetuate his memory, hence the endowment of this lecture and a medal to be given annually to the best student of the year for an essay on the subject which was so near his heart—anæsthesia In doing this Mr Mitchell, his son-in-law, and many other subscribers to the fund, acted as Embley, and indeed, any medical man would wish, and they chose, the practical and most certain method of keeping his memory alive and of maintaining a permanent interest in the subject of anæsthesia The gold medal will always cause keen competition among the students of this great University, and in your appointment of a lecturer you have the opportunity of honouring a senior man who has spent a great part of his life in the study of this branch of our work

May I express here my appreciation of the honour you have done me in choosing me to deliver this lecture, and my sensibility of the duty imposed upon me of bringing the subject up to date

As Professor Osborne so truly explained in the opening words of the first Embley Memorial Lecture in 1932, it is customary for the first lecture of a series to be biographical, and I am sure that those of you who heard, or have since read, that lecture, will agree that no one could have done it more ably It was written from the standpoint of a man who was Embley's close personal friend and for whose scientific and practical work he had a great admiration With the passage of time it can be given to few of the lecturers of the future to have this advantage, and, indeed, in a short time there will naturally be fewer and fewer men to be found who knew Embley personally It was my privilege to meet him in London in 1913 at the International Congress of Surgery, just before the Great War I heard him read his paper at that Congress on the "Dosimetry of

Chloroform", and followed him at the same meeting with a paper of my own on the earliest of the barbiturates, "Hedonal, and its use in Cerebral Surgery" Embley did me the honour of coming to the National Hospital, Queen Square, to see how this drug was given There he saw the late Sir Percy Sargent remove a lateral recess tumour under hedonal infusion anæsthesia I remember the incident well, as the late Sir Victor Horsley came into the theatre and, as he was very critical of this form of anæsthesia, he would not have it used for his own cases I am going to explain later that Horsley was an out-and-out advocate for chloroform and hence was a man after Embley's own heart, and they had a long discussion which was brought about by the modified form of the Vernon Harcourt inhaler in use at the hospital at that time This inhaler, as some of you may remember, was a dosimetric method for the use of chloroform That meeting, early one morning in 1913, twenty-two years ago, is clearly defined in my memory Horsley and Embley talked of chloroform in a way with which I could not then agree, but with which I am much more in symptathy now

Alas, of those four I alone remain Horsley, Embley, Sargent have all gone, and writing of them has made me wonder what they would have thought of the form of anæsthesia which, owing to the changed technique in surgery, I now practise in that same theatre Two of the greatest brain surgeons who have ever lived, who knew what they wanted and got it—a short, light anæsthesia—and an anæsthetist, Embley, who was all in sympathy What would these men have thought of the modern operation necessitating a perfectly quiet anæsthesia for any length of time up to eight or nine hours? This time-factor is a remarkable innovation I should like to have been able to say that a great advance has taken place, but I cannot make myself believe it, and already I see signs of these operations being speeded up and hear reports from other countries of the same tendency

In no department of surgery has a change been more marked since Embley's time than in cerebral surgery All my working life I have been closely associated with Sir Charles Ballance, Sir Victor Horsley, Sir Percy Sargent,

Donald Armour, the present staff of the National Hospital, and others, so I feel competent to speak with authority on this matter

The modern cerebral operation takes some surgeons anything from four to nine hours The fact that I have given anæsthetics for six successful cerebral cases in a day, none of which took more than hour, makes me wonder if the prolonged operations are essential Further than this, it became my duty during the war to operate on cerebral cases at St Thomas's Hospital

The fact that I cannot understand why it is necessary to be so slow, e g in removing a bone flap (two hours or more) and again two hours in sewing up a scalp does not concern this argument It is my business to provide an efficient anæsthesia, and that necessitates new methods I may here say that the modern prolongation of surgical processes does not apply only to brain surgery It applies also to general surgery—for example, three hours for an uncomplicated gastrectomy, two hours for enucleation of tonsils, two hours for a prostatectomy To return to brain surgery, where all the difficulties and dangers of anæsthesia are accentuated For instance, it is difficult to estimate the condition of a patient who is pulseless from traction on the medulla, or who from high intracranial pressure refuses to breathe These are both common occurrences in cases I am expected to deal with Compare all this with the light chloroform anæsthesia demanded by Horsley which, owing to his marvellous ambidexterity and speed, was all that was necessary—three gastrectomies one after the other in an hour and three-quarters, and the patients conscious before leaving the theatre Then came Sargent with division of the sensory root only This meant quiet anæsthesia for an hour, and as it happened he disliked the very smell of chloroform, he preferred ether preceded by atropine The ambidexterity of Horsley and the wonderful dexterity of Sargent are not given to every man their speed was wonderful, they had no reason to spend eight or nine hours on one case Surgical technique and asepsis prevent the anæsthetist obtaining access to the head, so other methods of anæsthesia than by the oral route had to be tried ether *per rectum* and intravenously, which had the objection of

boiling off at body temperature; paraldehyde *per rectum* and intravenously, alcohol intravenously All were tested, each had objections

In 1912 came the first of the long series of the barbiturates, hedonal—given intravenously After meeting Embley at the Congress in London in 1913, and after my paper giving the results of 85 brain tumours removed by this means, the war came and hedonal was unobtainable. My supply was soon exhausted and we had other things to think about I was doing heavy surgical operating work myself, so I took up ether again and used it by the intratracheal route with a Kelly's machine Many a time during the War I passed the intratracheal catheter first, then cleaned up and did the operation This anæsthesia was so successful that it remained my routine for over fifteen years after the War and long after my surgical efforts were over Sargent would have nothing else used for his cases Then some surgeons became infected by the slow motion bacillus, and ether under pressure for long periods was useless An expiratory valve was placed on the feed, a larger catheter used, and finally gas and oxygen as the vehicle for ether instead of air from a blower, which makes a quiet anæsthesia possible with smaller quantities of ether Such still remains my routine in cerebral surgery and up to date I know of nothing better

How Embley would have dealt with such a change can only be problematical, but in studying his published work, over which I have spent many hours, there is no doubt in my mind that he would have had much to say with the authority of many years' practical experience and with his great physiological knowledge behind him Judging from the mass of his scientific papers he was primarily a physiologist by inclination and an anæsthetist by necessity I do not think that the writer of the very critical, almost peevish letter to the *Inter-Colonial Medical Journal* in 1908, which elicited an editorial note, would not have expressed his views fearlessly This letter was due to some remarks by a coroner who had not credited Embley with some of his published work and, reading between the lines of the letter, there is no doubt that he had the same distrust of the value of the coroner's opinion as to the cause of a

death under an anæsthetic as many of us have now It is generally argeed that as scientific records the results of coroners' inquests are useless, and are not only incorrect, but are also harmful

Turning more particularly to his scientific investigation, Embley, working with Martin, on the basis of their work upon the circulation in the kidneys, pointed out that vaso-constriction is produced by a high percentage of chloroform in the blood If, however, this percentage is kept down to a level which can be produced by inhalation, vaso-dilatation occurs This causes the congestion of the venous system and the fall in blood-pressure, facts that are universally admitted This brought Embley into a controversy over the findings of the Hyderabad Commission The chief conclusion of the Commision was that death under chloroform was due to a failure of the respiratory system They denied that a primary cardiac failure occurred, and relied upon tracings which physiologists now say show a gradual weakening of the heart muscle Embley was one of those who did experimental work to prove this Such experiments as I saw at Chicago in 1923 leave no doubt in my mind whatever that chloroform has a direct action on the heart muscle in dogs when the air-way is rendered perfect by means of a tracheotomy tube My practical experience for over thirty years confirms this view

In 1911 Embley, in a presidential address in the Section of Anatomy, Physiology and Pharmacology, wrote a very able paper on "Syncope, Collapse and Shock" I can hardly believe he ever gave it as an address, it is too long and too involved However, it is the best paper I have ever read on the subject, full of original work, and should be read by every anæsthetist It stamps the writer as a thinker, a scientist and a practical anæsthetist, and although these observations were made by Embley in 1911 many of them might well be quoted in the *Manual of Anæsthetics*, published by the Melbourne Baker Institute of Medical Research in the next edition of their monograph He had the temerity to disagree with Crile's statement that gas and oxygen affords the most effective blockage of afferent nerve impulses reaching the central mechanism, and stated that gas and oxygen and ether were more efficient This statement

is in agreement with the modern trend of opinion, but it needed a bold man to express this view in 1911

In that paper, too, when dealing with shock, he points out the futility of using strychnine, especially during anæsthesia, a practice which we must all have seen resorted to, though many of us have been teaching its uselessness Ergot, pituitary and adrenalin come in for the same criticism When it was a common practice to use isotonic salt solution he was very downright about its abuse, as the fluid rapidly passes into the tissues causing general or pulmonary oedema The whole paper was years ahead of its time

In the *British Medical Journal* as early as 1902 Embley published three articles with numerous tracings on "The causation of death during the administration of chloroform" He starts off by quoting records he had collected of 124 deaths under chloroform, 107 of which occurred before the operation had begun He then gives a most complete history of all the experimental work which had been done on chloroform up to that date Following this he gives his own experiments on 289 dogs Some of his findings are, or should be, classical He says "Chloroform has an immediate and progressive effect on the heart muscle There is no preliminary period of stimulation There is no abrupt change in the rate of efficiency of the heart" In the second article again "Chloroform raises the excitability of the vagus mechanism particularly in the early part of the administration Dangerous inhibition is liable to occur whenever the strength of the chloroform vapour in the air inhaled rises above two per cent" Then again, "The cause of the fall of blood-pressure from administration of chloroform is paralysis of the muscle cells of the heart and of the arterioles The fall may be further augmented by the slowing of the heart's rate, or suddenly brought to zero by vagus inhibition of the heart" "Atropinization of dogs absolutely abolishes sudden heart arrest from chlorofrom" Failure of respiration in inhalation experiments is mainly due to fall in blood-pressure With good blood-pressure failure of respiration by inhalation of chloroform is practically impossible

From all this scientific work comes the clinical aphorism,

"Give atropine and take time in putting the patient under"

These articles produced a laudatory leader in the *British Medical Journal*, April 12th, 1902, showing how three years in the laboratory could produce immediate results in clinical work in saving life, and again emphasizing the importance of using a low percentage vapour for inhalation and the routine use of atropine They also brought two letters from Colonel Lawrie who naturally supported the dictum of the Hyderabad Commission, "Safety in plenty of air and plenty of chloroform" Another article contained an interesting statement about the routine anæsthesia used in France by Dastre and Morat who always gave a preliminary dose of morphia and atropine and who claimed "many thousands" of cases without fatality which was in contrast to their previous experience I only vaguely remember the storm which was going on at this time, but, looking back one realises that much of the chloroform mortality was due to pushing the anæsthetic too quickly, causing a holding up of respiration, a high concentration of vapour forming under the mask, then a long deep inspiration and consequent inhalation of an overdose

The later deaths were due to attempts to get relaxation for prolonged periods to enable the surgeons to perform the much more complicated and prolonged operations which were introduced even in those days

Embley, discussing ether anæsthesia, pointed out that the respirations are at first hurried and deep, subsequently they become slower and more shallow, and eventually, if ether is pushed to a dangerous extent, cease altogether Provided the respiratory acceleration is only moderate it assists circulation and so raises the blood-pressure, if excessive it has the opposite effect, and by increased lung ventilation lowers the tension of carbon dioxide, producing an acapnic condition Failure of respiration is rapidly followed by cessation of the heart beat These effects are also produced by exhaustion following over-stimulation, and should be kept constantly in mind when an inhalation is likely to be greatly prolonged The slowing and final cessation of the respiration appear to be ultimately due to poisoning of the respiratory system Blood-pressure is increased until very deep narcosis is present when a fall of blood-pressure occurs

The peripheral vascular dilatation, showing itself in the flush of the skin, together with sweating and recoder[illegible] the cause of this fall of blood-pressure When pushed to an extreme, death occurs and is due to a paralysis of the respiratory centre and to extreme vaso dilatation death by all the blood draining into the tissues. This is well shown in an example which I can demonstrate Death occurred in this case under deep ether anæsthesia without ing of oxygen The operation was the [illegible] in a child, and death occurred suddenly when the child had appeared well with a bright pink face, but a pulse Post-mortem, the heart and big muscles were empty Looking at the post-mortem histological evidence without knowing that death was due to ether any physiogist would say it was typical of a death from histamine shock We have three such cases in the records of St. Thomas's and no one would have taken more interest in them than Embley The question I should have put to him would have been "Are these deaths histomine deaths, due to oxidation of histadine from over oxygenation"? Embley worked out very carefully the effect of ether on the circulation He found that blood-pressure falls if measures are not taken to prevent peripheral dilatation of the vessels, but when ether is given by a closed inhaler, Clover for instance, this fall is corrected by the limitation of air incident to its use, and the maintenance of the tension of carbon dioxide What a vista of possible scientific research these slides conjure up This condition in the lungs, for instance, may be, and I think probably is, the cause of those spreading thromboses which are all grouped under the heading "ether pneumonias" The condition may also be conducive of the so-called collapse of the lung which when infected produces pneumonia Such cases became more common as surgery became more extensive and deliberate, as the demands of the surgeons became more insistent for relaxation This relaxation, when attempted with chloroform, was immediately fatal For years it was considered safe with ether, and then as the surgical demand became greater and greater it was evident that the after-effects were dangerous, and other means had to be found to satisfy surgical requirements

I have slides here showing death from another cause under ether anæsthesia So far as I know there is only one other record of such a death from fat embolism under anæsthesia The patient was a man of rather a flabby type, 35 years of age, who had been in bed more or less for over a year unable to walk The operation was for suture and lengthening the *tendo achillis* A student gave him an ordinary straight gas-and-ether anæsthetic and I noticed nothing wrong The operation was done with the man lying face downwards, and when he was turned over for plaster to be put on, it was noticed he was a pale colour He became restless and was muttering His colour became worse and I thought he was going to vomit so certain was I of this that I reassured the surgeon who wanted to know what was wrong However, there was no vomiting Restlessness and colour got rapidly worse and within ten minutes the man was dead Death was quite unlike anything I had seen before in a theatre, and was exactly like many deaths I have seen in old people after a prolonged illness—all the same symptoms and finally the change of colour I had no idea why that man died at the time and told the coroner so It was only a fortnight later when Professor Dudgeon sent for me to see these slides that I knew The coroner's verdict was " Death under ether anæsthesia" It was owing to his courtesy we ever found out the real cause, as he allowed us to have the necessary parts for histological examination Such a death is uncommon, but many others must have occurred and that they have not been recognised is due to want of the use of the microscope It is difficult to believe that ether could have liberated all this liquid fat into the circulation during the short time of the operation. There must have been several pounds of liquid fat present One of the chief points of interest in this case is the futility of the coroner's inquiry into the cause of death from a scientific point of view

That death occurs during operation from air embolism has always been suspected Dr Keith Simpson records three cases in the *Guy's Hospital Gazette* (February 16th, 1935) proved by careful post-mortem examination Without question the condition will now be shown to be more common as the pathologists will recognise the post-mortem

condition This paper certainly explains several deaths I have seen or heard of on the operating table which have been attributed to the anæsthetic, and what also interests me is that he gives details of the other death from fat embolism during anæsthesia I have been on the look out for such another case since I first published my case in my presidential address at the Section of Anæsthetics of the Royal Society of Medicine

Search has been made by many anæsthetists and surgeons for some means of producing relaxation by other means for long periods with safety By long periods I mean for over an hour, for up to that time ether seems reasonably safe in healthy people

So far this search has only been moderately successful in the lower abdomen it can be obtained by spinal anæsthesia which produces the only thing comparable to the relaxation produced by deep ether

There are no records that I can find that Embley did work on spinal anæsthesia which will produce such wonderful abdominal relaxation From time to time long papers are written describing the use of some particular technique and the use of one particular drug to produce anæsthesia in this way, and, undoubtedly, in some people's hands, spinal anæsthesia gives very good results which other people are unable to obtain From the early days of stovaine, which I first used in 1904, to the present time, when dilute, light, or heavy solutions of various drugs are used, technique and opinions have varied Generally, it may be said that spinal anæsthesia has found a place amongst anæsthetics, and that when surgeons have been unable to call upon efficient anæsthesia by other means, it is popular Dilute solution of percaine are in favour in London, especially for the lower extremities and abdomen Smaller doses are being given after preliminary narcotics and under gas and oxygen anæsthesia Removal of tonsils and such like operations were published in one series of reported cases Spinal headache is one of the worst complications which occur, while chest troubles are by no means unusual The headache can be a serious event when it occurs, as a preventative the Trendelenburg position seems to diminish the incidence In considering the causation of this headache

an interesting case has recently happened in my practice, when the patient, a middle-aged, healthy woman, had severe typical spinal headache—a rectal case to whom I had given avertin, and the surgeon required complete relaxation I proposed to give here the minimum dose of stovaine in saline, but although I am certain I punctured the theca I could not obtain any cerebro-spinal fluid, so following my fixed routine I gave no injection (incidentally the surgeon had the same experience) and finished the anæsthesia with gas and oxygen That lady had a severe headache for a fortnight although no cerebro-spinal fluid was withdrawn and no drug injected

It has been said that other means of producing anæsthesia have been searched for to replace the older inhalation anæsthetics, chloroform and ether, and great advances have been made in the last ten years in this search I may say I was very glad of the considered opinion of the Council of the Association of Anæsthetists of Great Britain and Ireland, given at the request of the Ministry of Health, that "mixtures of ether and chloroform acted in the same way as dilute chloroform, and were in fact more dangerous, as they gave a sense of false security " This applies, of course, only to mixtures of the liquids, not their vapour, as produced by Walter Tyrrell in 1898, on which principle all modern methods are founded The advance has chiefly been in the use of various drugs as preliminary medication to enable gas and oxygen anæsthesia to produce a condition suitable for surgery and to abolish the psychical effect of fear before operation There is no doubt that gas and oxygen is the least harmful of all anæsthetics, but if it is attempted without producing anoxæmia and without supplementation by drugs it is inefficient for any prolonged surgical procedure Gas is exhaled unchanged and is not absorbed by the tissues It can be used over and over again by breathing through soda lime to absorb carbon dioxide from the expired gases this is a great economy of gas and is economic both from the quantity used and by making the necessary apparatus more portable In this connection Bohr's statement that "lack of CO_2 causes the haemoglobin of the blood to hold on more tightly to its oxygen", must be remembered An anæsthetised patient

may therefore appear to be properly oxygenated while actually suffering from anoxæmia Yandell Henderson has pointed out that CO_2 starvation may occur during anæsthesia, and this is more likely to occur when a plenum method is employed Both these statements, which are fully substantiated, make some form of rebreathing essential, and there is practical evidence of the want of CO_2 when using the soda lime circuit for prolonged periods

The drugs by which this preliminary narcosis or basal narcosis, as it has been called, is obtained, are very varied and may be divided up into the following groups

1 Opium and hyoscyamus derivatives
2 Avertin and paraldehyde
3 Barbiturates

None of these are given as anæsthetics by themselves, but simply as accessories to abolish nervous shock and to enable gas and oxygen to be given either by themselves or with the addition of small quantities of ether With the exception of Class I these are comparatively modern and have really only come into general use since Embley's time Taking them in the above order, three common forms are in use

1 *Morphia, Scopolamine* (*Hyoscine Hydrobromide and Omnopon*

Their use is well known The first two were used together and produced that condition which was known by the wonderful name "twilight sleep" The public at one time were much enthralled by wonderful descriptions of this condition in the lay press with reference to its use in midwifery The method has fallen a great deal into disuse owing to its universal use and abuse It most distinctly has its uses Two tabloids known as tabloid hyoscine A and B are on the market made by Burroughs Wellcome & Co , and with them it is quite possible to get a patient to the operating table without any recollection of the fact and to procure a very quiet anæsthesia with gas and oxygen, or relaxation with spinal anæsthesia The disadvantage is that respiration is too shallow to permit sufficient anæsthetic to be inhaled to procure relaxation Omnopon is used in the

same way, it being about half the potency of morphia, while it is claimed to produce less sickness and disagreeable after effects These drugs are used hypodermically and take varying times to act By using about a quarter of the hypodermic dose, morphia can, and is, given intravenously when it acts very quickly and uniformly

2 *Avertin and Paraldehyde*

These are the two principle drugs used as basal narcotics by the rectal route Avertin is the most popular and has an extensive vogue It is also the most modern and was introduced into the British Isles from Germany Its use is simple, there have been very few fatalities Patients as a rule like it and it has few post-operative sequelæ It is simply tri-brom-ethyl-alcohol and the solution is very easily prepared Like every other drug its use needs care The manufacturers (Bayer) issue comprehensive tables for this purpose, it being given according to the body weight— 1 gr per kilogramme of body-weight is the standard dose Such a method of estimating the dose can at best be only an arbitrary one For instance, it would have been fatal to give the acromegallic doctor of 24 stone, I had to deal with a short time ago, 24 stones' worth of avertin, equally it would be futile to give an extremely thyrotoxic woman of four and a half stone, four and a half stone's worth The anæsthetist must see the patient first, and bearing in mind the nature of the operation and relying on the standard dose, the avertin weight of each individual must be estimated and the dose given accordingly Thus the avertin weight of the 24-stone patient was estimated at 14 stone and the thyrotoxic lady at seven stone These estimations both worked satisfactorily It is astonishing how little anæsthetic is required by these people when the dose is correct, but it is better to give too little avertin than too much as the anæsthesia is so easily controlled after the skin has been incised The retrograde amnesia is very pronounced and the patients will even talk apparently rationally without any recollection later on. The solution must be made up freshly for each case and, paying strict adherence to the rules drawn up by the manufacturers, should be given about half an hour before operation When it was first introduced large

doses of morphia or omnopon were advised to be given with it, and I think much of the adverse criticism to avertin was due to their use as they depressed respiration I never give morphia before avertin and am very careful of doing so after Avertin lowers the blood-pressure, a fact which can be made use of in cerebral surgery, and it is interesting to watch a rise in blood-pressure after about an hour during such operations Frankly I do not like it for abdominal work unless the surgeon is competent and willing to use some means of blocking off the nerves Some such aid is necessary to secure relaxation of the abdominal muscles I use it for all orthopædic work for which I am constantly giving anæsthetics That avertin is not so free from after effects as was at one time supposed is now well recognised Headache, restlessness and vomiting occur, and many people are met who prefer the straight nitrous oxide ether sequence To one girl I gave three avertin anæsthetics in a week and after the last she had a condition which was indistinguishable from a mild attack of so-called chloroform poisoning Avertin has won a place amongst anæsthetic drugs and has come to stay

There are several definite contra-indications to its use. (1) The existence or history of any form of colitis; (2) obstructive interference of the air passages, (3) after premedication with heavy doses of opium

Paraldehyde is one of the safest drugs we possess and has a very wide margin of safety Its objections are its insolubility (℥i to ℥iℊ of saline) and to some people its horrible smell Again, it is used by body-weight ℥i to the stone It is extremely useful in children, and morphia can be used to intensify its action Lately it has again been used successfully in maternity work and, if given before the head has engaged in the pelvis, when it is possible to inject it high up the rectum, it gives peaceful sleep while labour continues unaffected The babies reek of it, but do not seem unduly sleepy It has been stated as a contra-indication to its use that the babies do not take their food well in the first two weeks of life, and that in a series of cases their increase in weight was not up to the average In adults, for general surgery, the bulk of fluid which has to be used makes its use difficult and it is apt to act as an

enema and give uncertain results It is more soluble in oil, but the absorption is not so good

Nitrous oxide anæsthesia, with or without oxygen, was, of course, well known to Embley as it had been in use for many years before his time and machines were in existence to give more or less accurate mixtures and percentages Early in this century these percentages had all been worked out by Hewitt who had a percentage inhaler and was quite cognisant of the value of giving the mixture under pressure which he recognised as being necessary when using nasal gas and oxygen The method of controlling the flow of gases was crude In fact, the only way of doing so was to allow them to escape from the storage cylinders into elastic rubber bags Next from America came the Gwathmey machine with control reducing valves on the cylinders It is upon the principles of this machine that all modern gas and oxygen machines were founded I had one of these early Gwathmeys and it is still in use in South Africa They owed their success to the fact that it was possible to add at will large or small quantities of ether to the mixture of the gases, and made frank recognition that gas and oxygen *per se* as an anæsthetic was futile except for the very shortest and minor surgical procedures Premedication and the addition of small quantities of ether have made gas and oxygen possible as an anæsthetic and have enabled the surgeon to operate for hours at a time with impunity The machines now on sale are innumerable, but they all have this in common, that ether can be added at will and definite known percentages can be given The newer and more complicated can give a high pressure and rebreathing Personally I prefer simple apparatus and I use the simplest form I know At the other extreme is the latest form of McKesson which is the Rolls Royce of these machines

The machine which you have produced in Australia is all that can be desired and is efficient The cry which was raised of the expense of the gas and difficulty in transport is now no argument as it can be used over and over again as long as the expired carbon dioxide is removed by soda lime An efficient method of doing this is becoming popular in London chiefly on account of portability, as the cost of gas is not so great as in this country

There is no question that nitrous oxide is the least toxic of all anæsthetics, but equally without anoxæmia or the use of adjuvants it is the poorest, and relaxation cannot be obtained with its use alone Scopolamine, morphia and omnopon are all useful in this connection, but something more is wanting Avertin and paraldehyde have been discussed shortly, but it is in this search for premedication before gas and oxygen that there is much diversity of opinion about the value of the countless forms of barbiturates Their very multiplicity and complexity is bewildering every one is hailed as the best, used by enthusiasts, until a fresh one appears The ideal has not been found, and personally I have no great faith in the group known as the barbiturates producing it Those of you who can remember the introduction of veronal as a universal hypnotic will remember numerous disasters which were reported from overdosage and idiosyncrasy Hedonal showed that this same sensitiveness to the drug varied in various people when given intravenously What is put into a vein is irrecoverable, but I believe the action is more uniform than when given by the mouth as the drug is more certainly taken into the blood stream unaltered Administered in this way they are safer and the disasters which have been reported after the use of veronal by the mouth do not occur Many of the observations made in 1912–1913 about hedonal can be made about the newer drugs, but the attempt to produce a surgical anæsthesia entirely by their use has almost been abandoned The chemical formula of all these barbiturates is very similar, in fact it is difficult to distinguish one from the other Although I have had experience of the majority I rarely use them now I prefer scopolamine, morphia, avertin and paraldehyde as being safer and more certain The barbiturates I have used intravenously are hedonal, isopral, nembutal, pernocton and evipan, in that order There are many others but they are given chiefly by the mouth, and of these undoubtedly medinal and others are useful Embley saw me use hedonal about which I was enthusiastic at the time, he was certainly interested, but both he and Horsley looked upon it as a passing phase, and they were right

We pointed out from St Thomas's in 1913 that any form

of opium should only be used with great care when this class of drug had been used this is now generally accepted Before leaving London I saw several tubes containing another mysterious anæsthetic, another barbiturate said to be much superior to evipan! It had not even been christened and was only designated by a number

Professor Haas, of Munich, was in London recently, he told me that he had given up the use of the barbiturates in surgery and was relying upon avertin He told me of a death he had in an ordinary quiescent appendix in a healthy young woman Pernocton was the drug used And he told me of dangerous symptoms in other cases when using the same drug It is rather disturbing to hear such stories about one or another of these drugs from various sources in casual conversation

The position of the barbiturates remains obscure It is not all clear what is going to happen In the hands of some enthusiasts much better results are obtained than can be obtained by other people, but when seen in action they are not quite all that is claimed for them Just as 13 years ago, when I was in America, I saw the same old difficulties occurring in the hands of experts that I had experienced myself when using less complicated machinery about which there was no need to be so enthusiastic I saw the very early ethylene anæsthesias, and, good as they were, I heard the same complaints of the surgeons about want of relaxation, which seemed to me to be amply justified

Another disadvantage in the use of all basal narcotics is an economic one, as the prolonged sleep, restlessness and then ataxia necessitate special nursing for 24 hours

During the last 11 years there has been a great increase in the use of intratracheal insufflation and this again has been due to a demand for a prolonged quiet anæsthesia There has been a decided change in the technique of this method since its introduction into England by Kelly, of Liverpool, in about the year 1911 It was originally founded on Elsberg's and Meltzer's work in America, and Kelly, when he returned from a visit to the States, designed a machine of a simple form which depended on a current of air containing a known percentage of ether being delivered under pressure at the bifurcation of the trachea This was

done by means of a semi-rigid catheter passed between the vocal cords and down which the current of air, laden with ether, was passed under pressure Expiration took place through the space in front and behind the catheter and was more or less continuous From the perfect oxygenation, due to an abnormally clear airway, long periods of acapnia resulted I had one of the very early machines which I used at St Thomas's and I had a simple form built on to a table at the National which was in use until about 18 months ago Gradually it became evident that larger sized catheters gave the best results and then, instead of using pressure, respiration was allowed to take place backwards and forwards through these larger catheters through which the anæsthetic vapour is inhaled Inhalation is rendered possible by the use of an expiratory valve on the delivery tube and gas and oxygen, either with or without small quantities of ether, is inhaled These catheters are best passed visually between the cords after anæsthetisation, or, as suggested by Magill, a softer variety may be passed blindly down the nose The knack of doing either is readily attained by practice, but to me it seems better, although the more tedious, to pass the catheter by direct vision down a clean bronchoscope, than down a possibly septic nose These methods are now used most extensively, and I have no hesitation in some of the cerebral work in using dilute chloroform vapour Here again the enormous length of time required by some surgeons for the most trivial operations negatives the use of continuous ether, and all the basal narcotics have failed in cerebral surgery, with the exception of avertin The prolonged cases do well when gas and oxygen is inhaled down a catheter with a minimal quantity of ether

Laryngologists have recently taken exception to this method of anæsthesia, as they claim to have seen cases of permanent damage to the cords I can well understand this may be true though so far I have not had such a case brought to my notice It is essential before the catheter is passed to have the adductors of the cords paralysed, and this only occurs when anæsthesia is deep Years ago David Ferrier showed that the abductors were paralysed before the adductors, leaving the latter unopposed This means

that the catheter should not be passed until the adductors have been paralysed also and are no longer the white glistening structures such as we expect the cords to appear Cocaine has been used in very high percentages to obtain this effect I cannot see the necessity for the use of cocaine as it adds another poisonous drug, and given sufficient skill and practice in this manœuvre it can be dispensed with It is the paralysis of the vocal cords which gives such a clear airway when using a deep ether anæsthesia In fact when the paralysis occurs as it does very suddenly it is then and then only that the perfect relaxation of this form of anæsthesia occurs The patients are suddenly given the best and freest airway they have ever experienced, their lungs are ventilated as they have never been before, there is over-oxygenation of the blood and a loss of carbon dioxide In this way the very quiet shallow respiration occurs which is associated with deep ether Indeed the next stage is an acapnia which is liable to be alarming unless properly understood For short periods this form of anæsthesia appears to be perfectly safe and most satisfactory for those surgeons who are quick over their work I know many surgeons who rely upon the relaxation of deep ether to get their speed and to attain results free from after complications These remarks are chiefly applicable to high abdominal surgery and it is an education to see such rapid experts sewing up a slack peritoneum with a straight needle after doing a difficult gastrectomy in under 40 minutes Speed in these cases (if not in all) is the greatest factor of safety in surgery

Of recent years in England there has been a popular outcry fostered by the National Birthday Trust Fund to provide anæsthesia for every woman who is in labour It is a popular appeal and one with which every medical man or woman must be in sympathy Unlike many popular movements the people responsible for the fund have endeavoured to determine the best and most practical anæsthetic to entrust to the midwife A strong committee of the New Obstetrical College in London is now investigating many hundreds of reports from residents in hospitals, midwives and pupils The agents chiefly considered are nitrous oxide and chloroform, used as analgesics rather than anæs-

thetics and in such a manner that they are self-administered under instruction from a midwife who has herself had special tuition Nitrous oxide with oxygen has been used for many years for the purpose in the United States of America It serves its purpose in America for Institutional treatment but is almost impracticable for domiciliary work Nearly all confinements take place in hospital in the U S A whereas the vast majority of labours in the British Isles take place in the patients' homes, so that if nitrous oxide is to be used a more portable machine is essential Minnitt, of Liverpool, has attempted to supply the want by means of a more portable machine for the automatic intermittent delivery of nitrous oxide and air to the patient This machine is now on trial, in the hands of experts in hospitals it is all that is claimed for it, but it is far from really portable and the patient needs education in its use At home chloroform has been the almost universal analgesic for midwifery and came into general use after being given to Queen Victoria during her later confinements "Anæsthesia a la Reine", as it was known for years The employment of chloroform has the great advantage of portability and simplicity, but it is particularly liable to be pushed too far Chloroform given to the obstetrical degree has to be fully understood, for it can certainly retard labour and be dangerous The two methods of giving it which are being chiefly investigated are (1) Chloroform capsules, (2) Mennell's bottle

The capsules are of the familiar amyl nitrite form, each contains 20 minims of chloroform which should be broken on a mask one at a time The patient then inhales the chloroform holding the mask near or on her own face Under supervision the method works well, but the patient cannot be expected to break the capsules herself The maximum number I have heard of used for one recorded case is 129 This means a big quantity of chloroform and certainly cannot be considered safe in the hands of the inexpert, or without danger in the hands of any but real experts The bottle which goes by my name is a modification of the junker inhaler which I have attempted to make foolproof That it is so will readily be seen, and provided the bottle containing the chloroform is not heated, anæsthesia cannot be induced It can produce analgesia or what

I believe is more important still—amnesia No method of giving chloroform can be free from the risk of the so-called "delayed chloroform poisoning" In considering this point it must be remembered that the toxæmias of pregnancy very closely simulate this condition and occur when no chloroform has been given It is interesting to see the differences in the reports from the various centres regarding these methods It will be equally interesting to see the ultimate opinion as to what should be taught the midwives

Ethylene, acetylene and other gases of the same group have been used as anæsthetics, but have not gained popularity in England Cyclopropane is the newest (and at present the most expensive) gas to be tried Di-vynyl ether or vinethene, as it has been called, is said to fill a gap between chloroform and ether All these anæsthetics are on trial and may in a few years' time have proved their value and safety sufficiently to be discussed more fully in the next Embley lecture

What is the outcome of this lecture? There is now a bewildering multiplicity of methods of producing anæsthesia Embley's plant has become a shrub, one which wants pruning The undergrowth is overgrown, but the main branches show a healthy growth, and the fruit it bears is already of great assistance to mankind What this shrub really wants is attention to the roots, more of the spade work put in by men like Embley, the physiologist, to determine the exact action of all these drugs, and to tell us the nature of this condition which we know as anæsthesia

From a practical standpoint as an anæsthetist of many years experience the message I should give in conclusion is Keep a clear airway, use as simple machinery as is compatible with efficiency, and remember that even in this mechanical age there has to be human control of the machine It is the man behind the machine that counts in anæsthesia

PARALDEHYDE IDIOSYNCRASY

Report of a Case

By Gilbert Brown, M B Ch B (Liverpool),

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MR G H, aged 20 years, weight 123 lbs, had suffered from hæmatemesis for which a gastroenterostomy had been performed about a year previously A few months later there had been another profuse hæmetemesis and he had lost one stone in the last six months An exploratory operation was decided upon and he went into hospital

When examined on January 2nd, 1934, he was found to be rather anæmic but showed no other abnormality, his blood-pressure being 120–78 He was given nembutal gr 1½ at 9 p m and slept well The following morning at 8 a m (January 3rd, 1934) he was given four drachms of paraldehyde in five ounces of normal saline solution *per rectum* He went to sleep and, as the sedative effect was fairly marked, only morphine gr 1/12 and atropine gr 1/100 was given at 9 15

He was asleep when brought into the operating theatre, and at 10 22 the anæsthetic was commenced, 8 0 c c of ethyl chloride and 20 0 c c of ether, by the open method, were required for the induction An endotracheal catheter was introduced and ether continued by means of Connell's apparatus The amount of ether required for the maintenance was noticed to be less than usual

Operation The operation was begun at 10 36 by Sir Henry Newland The abdomen was opened and the duodenum and stomach inspected, no sign of ulcer or scar could be detected and so the duodenum and pylorus were opened The mucous membrane was injected and redundant, one spot was suspicious of a punctiform ulcer A strip of mucous membrane was excised and the bowel closed The previous anastamosis was found to be patent The abdomen was closed and the operation concluded at

11 33 A blood-pressure chart was kept during the operation, the record showing Before operation, pulse 96, respiration 20, blood-pressure 120–74, after operation, pulse 120, respiration 36, blood-pressure 114–70

On his return to bed he was given a glucose-saline rectal injection and 10 units of insulin subcutaneously Carbogen was also given every three hours for three minutes At 12 30 it was noticed that his respiration was 44 per minute and labouring in character, the pulse-rate was 120 Oxygen was administered by nasal catheter and some improvement took place At 4 p m the breathing was more laboured and mucous was troublesome Ten ounces of saline and glucose solution was given *per rectum* and 1 0 c c of coramine intramuscularly

When seen at 5 30 he was found to be deeply unconscious, the pupils were dilated and the corneal reflex was absent The temperature was 102 2°, respiration 48, pulse 124, blood-pressure 118–70 No reflexes of any kind could be obtained A catheter was passed and 12 oz of urine was withdrawn, this showed no albumin, sugar, acetone, or diacetic acid Coramine 1 0 was given intravenously At 7 30 his respiration was shallower, air entry into the bases of the lungs was deficient, but no adventitious sounds could be heard Carbogen was administered and this was later followed by continuous oxygen At 8 30 the continuous administration of saline was begun by rectum At 10 p m the saline was returned It was then noticed that his pupils reacted to light Temperature 102 4°, respiration 52, pulse 128 At 11 p m a hypodermic injection of strychnine gr 1/30 was given and this was repeated every four hours The rectal saline was continued At 4 a m the respiration was 60 Coramine 5 0 c c was given intravenously and his condition improved The blood-pressure was unaltered At 5 a m the temperature was 103°, respiration 72, pulse 136 At 8 a m he moaned and moved his head slightly At 9 30 a m bronchoscopy was performed in the bed by Dr R H Glynn and suction was applied to the bronchi Towards the end of this operation the patient began to move his head and became restless

Following this coramine 5 0 c c was given intravenously and 10 units of insulin subcutaneously Lumbar puncture

was suggested but was not performed At 10 50 a m he showed signs of returning consciousness which gradually increased until 12 30, he kept lifting his head off the pillow and moved his arms and legs By 1 p m he was very restless and had to be restrained. At 4 30 he was able to swallow sips of water At 5 10 he opened his eyes several times At 5 55 he opened his eyes on command, but was very restless. During the night he became quieter, his temperature gradually became lower, and at 4 30 a m. (temperature 98°, pulse 112, respiration 28) he sat up At 6 30 he spoke distinctly and asked for a drink From this time he gradually became more conscious, complained that his throat was sore and that he had pain in his abdomen He dozed occasionally but took nourishment freely He made an excellent recovery from this time without any further complications

Points of Interest (1) Complete loss of reflexes, even that of eyes to light and corneal reflex (2) Very little depression of blood-pressure 3) Rapid respiration (4) Rise of temperature (5) Diminished air entry at bases (6) Probably paraldehyde idiosyncrasy combined with some collapse of the bases of the lungs The latter was treated by carbogen inhalations, coramine injections (18 0 c c in 24 hours) and by bronchoscopic suction

Summary A case of paraldehyde idiosyncrasy is reported in which prolonged deep unconsciousness took place after a dose of only four drachms

ANÆSTHESIA—ITS PRESENT AND FUTURE

By W Stanley Sykes, M B , B Ch ,

Anæsthetist to the General Infirmary at Leeds and to the Hospital for Women, Leeds, late Anæsthetist to the Leeds Dental Hospital

"SCIENTIFIC research gives courage and a fundamental serenity It is the securest refuge from the distresses of the human soul the pathway to great adventures and limitless service "

These are the words of Mr H G Wells His ideals and his opinion are tacitly backed up by many anæsthetists who work under conditions so discouraging that intense keenness and a fervent desire to improve their craftsmanship are almost their sole recompense

The quotation continues " Its pay and emoluments are the least of its rewards " An exegetical scholar might be pardoned for deducing from this internal evidence the fact that Mr Wells is an anæsthetist himself !

The most optimistic enthusiast can hardly claim that the science and art of anæsthesia has reached or even approached perfection and finality The multitude of methods in common use at once negatives any such complacency The most far-reaching claim possible is that a high standard is reached at some hospitals But in far too many of these institutions anæsthesia is the Cinderella of medicine,starved, neglected and utterly unprogressive This backwardness, though regrettable, would be more easily comprehensible if anæsthesia were of little practical importance or if it affected only a negligible proportion of patients As, however, it vitally affects the comfort and very safety of about 50 per cent of all people admitted to general hospitals and nursing homes it is evident that only the very best is good enough, and that stringent constructive criticism is constantly required in order to lift anæsthesia into the forefront of scientific progress and keep it there

The ideal aimed at by all competent anæsthetists is threefold First and paramount is the safety of the patient Deaths during and after operation will always occur so long as major surgery is undertaken and so long as bad risks are given their last, least chance of life regardless of the virginity of our statistical tables But the risk must always be cut down to its irreducible minimum This implies post-operative safety as well as safety at the time, From the patient's point of view it profiteth nothing if he gets off the table alive only to die from some anæsthetic complication several days later

Secondly, the comfort of the patient In the interests of all concerned anæsthetics should invariably be made as pleasant as possible Apart altogether from humane considerations a patient who has had a pleasant anæsthesia will be less apprehensive and less reluctant to undergo any further surgical interference which may be necessary

Thirdly, the convenience of the surgeon This, while important, is entirely subordinate to the interests of the patient Any anæsthetist, after a year or two of experience, can guarantee very deep anæsthesia in the vast majority of cases—deep enough to pacify even those extremely dangerous surgeons who insist on the patient being nearly dead when opening the abdomen But an anæsthetist who blindly goes all out to satisfy the surgeon with the deepest possible anæsthesia is betraying his trust to the patient He may get more fees from that particular operator, but they will inevitably be bought at the price of a higher mortality rate

Is it too much to ask that a reasonable fee be paid for the skill and experience which enables an anæsthetist to approach this threefold ideal with a fair degree of certainty? One hesitates to stress this point but it is no use ignoring it It is a fact that in many places anæsthetists are badly paid This inevitably leads to overwork, with the result that there is no time for anything more than a mere mechanical routine Imagine an operating surgeon so underpaid that he has no time to see his patients before or after operation He would be in grave danger of degenerating into a mere artisan He would never see the results of his own mistakes and they would pass unrecognised and uncorrected He

would not see the effect of alterations in technique and methods and so he would never know whether they led to improved results or the reverse In short, he would learn nothing

A great many, perhaps the majority, of anæsthetists in this country are in this very predicament A vast untapped river of clinical material is constantly running past them to waste, and for reasons which are largely economic no attempt can be made to utilise it or to extract from it the knowledge wherewith to make the art of anæsthesia safer and better than it is to-day

It will be convenient to describe the defects of the present system as carried out at a large teaching hospital * For the most part the organisation is as strict as could be found anywhere No one can hope to aspire to the surgical staff without the F R C S and many weary years of apprenticeship The result is that the hospital has acquired a high reputation for surgery This reputation, firmly rooted in the columns of the local newspapers and aided by occasional boosts from chairmen of appeal committees, stands somewhat less securely on its foundations when it is realised that the department of anæsthesia, that integral and important part of surgery, is regarded as of little importance

The hospital has a total operation list of 12,000 a year, 8,000 of which are in-patient operations In spite of this huge total there is no resident anæsthetist Emergencies and odd cases operated upon when no visiting anæsthetist is available are generally dealt with by unskilled and unsupervised students This unsatisfactory and dangerous practice is conceivably permissible in a remote country district, but it is impossible to imagine any justification for it in a teaching hospital Bad in itself, it has many undesirable subsidiary effects which permeate and vitiate the whole surgical outlook of the hospital

As may be imagined, if anæsthesia is thought to be so easy and so foolproof that an unsupervised dresser can be

* The defects in methods, organisation and equipment mentioned in this paper are all facts, seen by the writer at various hospitals Similarly, none of the suggested improvements can be dismissed as Utopian or impracticable, because again they have all been seen in actual use by the writer

entrusted with it, the arrangements for the practical instruction of students in this subject are very unsatisfactory No time is specifically allotted for this purpose and students are supposed to pick up what they can during their surgical appointments Obviously tuition would be far more efficient if the visiting anæsthetists had definite pupils to instruct instead of, as at present, a heterogenous crowd of dressers whose interest is largely taken up by their surgical duties

The moral effect of the whole system is bad Students trained at a school where anæsthesia is carefully taught and regarded as an important part of surgical team work are not only more competent but, being more competent, are better able to realise their own limitations On the other hand students who are accustomed to see the work casually handed over to untrained men can never be well taught, for they are bound to think either that there is nothing to learn or alternatively that they already know it all And who can blame them? The fault is not theirs but that of the surgeons who tolerate such a system The students have no conception of the importance of the anæsthetic as regards the comfort and safety of the patient, and they also fail to realise that they themselves are less competent than the expert Sooner or later this unjustified self-confidence leads inevitably to disaster, for nothing is more dangerous than the rashness of complacent ignorance

The same weird principle—failure to realise that anæsthesia requires any special training or experience—is applied to the election of the visiting anæsthetists When a vacancy occurs it is filled by any applicant, so long as his name is on the Medical Register No evidence of proficiency or previous experience is required, an extraordinary method of appointment which applies to no other branch of medicine or surgery

As a result of this a vicious circle is set up—the surgeon to whom a recently appointed novice is allotted naturally gets bad anæsthetics for some years Therefore he does not give his anæsthetist any private cases Then the latter becomes dissatisfied because the hours he spends in hospital do not lead to any paid work, and he either resigns altogether or transfers to another surgeon at the first opportunity It is a fact that changes in the anæsthetic staff of

this particular hospital are rather frequent The surgeon then starts the whole weary business over again with another raw novice Net result, some surgeons never do get satisfactory hospital anæsthetics—some anæsthetists have their enthusiasm crushed out of them altogether

(To be continued)

THE DIPLOMA IN ANÆSTHETICS

THE following is the list of those to whom the Diploma has been granted under the special regulations

Ashley Skeffington Daly, L R C P , M R C S , 1905

Henry Walter Featherstone, L R C P , M R C S , B Ch (1917), M D (Camb), 1924

Christopher Langton Hewer, L R C P , M R C S. (1918), M B , B S (Lond), 1920

John Brook Henderson Holroyd, L R C P , M R C S , 1910

Archibald Daniel Marston, L R C P , M R C S (1915), L D S , R C S (Eng), 1913

Zebulon Mennel, L R C P , M R C S (1900), M B , B S (Lond), 1901

Arthur Joseph O'Leary, L R C P and S (Edin), L R F P and S (Glas), 1903

Harold Sington, L R C P , M R C S , 1905

George Francis Rawdon Smith, M B , Ch B (Liverpool) 1907, M D 1913

William Stanley Sykes, L R C P , M R C S (1919), M B , B Ch (Camb), D P H (Leeds), 1921

H E G Boyle, *O B E* , L R C P , M R C S 1901, F R C S 1935

R Brown, M B , Ch B (Aberdeen) 1905, M D 1907

J M Clark, M B , Ch B (St Andrews) 1919

F T Evans, L R C P , M R C S 1921, M B , B S (Lond) 1932

C F Hadfield, L R C P , M R C S 1904, M D (Camb) 1906

F Whalley, M B , Ch B (Leeds) 1905

ABSTRACTS

"Reaction of the reticulo-endothelial system of the lungs to inhalation of ether and chloroform vapours A FILIPPI *Annal Ital di Chirurg*, March 1935, p 271

The author carried out experiments on rabbits and made microscopic investigation of the lungs after differential staining In the first group of rabbits, treated by inhalation of ether for one hour and killed either immediately after narcosis or at the end of the subsequent four days, he was unable to demonstrate modifications in the character of the staining or any morphological change in the fibres of the reticular system In the second group treated in the same way with chloroform certain findings could be regarded as abnormal, but the author says that in the light of present knowledge of the reticular system and of its mode of reacting to disease stimuli we cannot affirm with certainty that the appearances described are to be attributed to damage produced by chloroform products Simple facts are demonstrated which further studies must confirm or deny

"Vinethene" G W DORFFEL *Deutsch Med Wochensch*, June 14th, 1935, p 955

The author writes of 200 administrations He regards vinethene as a valuable anæsthetic for short operations and has not employed it for any operation lasting more than 15 minutes He has used only a simple open method, which accounts for the inefficient anæsthesia obtained in a healthy young boxer He regards the drug as an excellent one to use on patients with poor heart action After effects were noticeably few, as one might expect after such short administrations, only three of the 200 patients were sick

"Susceptibility and resistance of tissues to general anæsthetics PROF D DE B MACNIDER *Anæs and Analg*, May–June 1935, p 98, etc

Interesting observations are recorded on behaviour of liver and kidney cells under various anæsthetic influences

The parts played by age of subject and by the state of pregnancy are investigated Animals during pregnancy are much more susceptible to toxic action of ether than unimpregnated females of the same age Susceptibility increases with the age of the animal A part of the organotropic susceptibility of the animals to anæsthetics has been found to be associated with the same type of cytological modification (as produced by lung inhalations), an increase within the epithelium of the liver and kidney of lipoid material The author's main object was to point out the important relationship which anæsthetic substances may have to tissues other than those of the central nervous system

"Studies in water requirements of surgical patients" A Coller and W G Maddock *Anæs and Analg*, May–June 1935, pp 140–144

The authors draw attention to the importance of the continuous insensible loss of water This may be the largest amount of outgoing water during recovery period after operation and may vary from 1,000 to 2,500 c c daily in an adult surgical patient Dehydration by vomiting, diarrhœa, biliary fistulæ, etc has received comprehensive study On the other hand vaporisation of water from lungs and skin has been given too little clinical consideration Estimation of this loss has enabled the authors to provide accurately for the water requirements of surgical patients and has shown a negative fluid balance to be the cause of grave clinical conditions, the correction of which has prevented death

"Antalgic therapeutic methods accessible to anæsthetists" Prof A M Dogliotti *Anæs and Analg*, July–August 1935, pp 150–158

The author recommends and describes the use of various injections, the most important being subarachnoid spinal injection of absolute alcohol for the treatment of sciatica, neuralgia and some abdominal pains The treatment is analagous to the injection of alcohol for trigeminal neuralgia Dogliotti first proposed it in 1930 and has employed this method many times since that date He records, for example, 178 cases of "rheumatic sciatica", with 148 cures,

25 improved and five unaffected The method is based on the principle that absolute alcohol is lighter than cerebrospinal fluid It is injected drop by drop and the roots to be affected are kept uppermost Only ½ c c is used

"Effect of general anæsthetics on hydrogen ion concentration in blood and urine" B KANET *Tohoku Journ Experim Med*, p 291

The author has investigated the effect on ion concentration of a number of general anæsthetics including, besides commoner agents, avertin and ethyl chloride His results were much as might be expected from our previous knowledge The experiments were carried out on guinea pigs Generally speaking the hydrogen ion concentration of the blood directly after narcosis and of the urine four hours later was raised The height of this rise and its duration varied according to what anæsthetic had been employed and according to what length of time that the inhalation had lasted, chloroform causing the most notable and nitrous oxide the least variations

REVIEWS

"Problems of anæsthesia in general practice" Dr H Lukis, p 158, price 7/6, Hodder & Stoughton, London

This book in essay form was awarded the Sir Charles Hastings prize of the British Medical Association It well merited the success, for it is full of sound information and advice based on the author's own experiences The book will be of most use to those practitioners who are only occasionally anæsthetists For them it will prove of great service, whether they seek advice as to when they should call in an expert or trust to their own comparatively limited skill, or whether they want instruction as to the actual management of a patient difficult from the anæsthetist's point of view The estimation of anæsthetic risks, and the problems presented by special operations are so well discussed that the author's words may be read with advantage by the specialists themselves Nevertheless, it is the practitioner's own point of view that is kept in mind throughout the book He is advised to be sure, before giving an anæsthetic, that he has the confidence of the patient, the surgeon and himself, Dr Lukis's advice with regard to the two latter is as sensible as it is wittily expressed We strongly recommend this little work for the perusal of the readers

"Theory and practice of anæsthesia" By M D Nosworthy, M A , M D , B Ch (Cantab), Anæsthetist to Westminster Hospital London Hutchinson Scientific Publications 1935, pp 223, 12s 6d

We know no better small book than this for any man to study when he is beginning to give anæsthetics That is not to say that it contains no substance for the experienced anæsthetist, indeed, it is so well conceived and clearly written that the expert may gain much from its perusal Dr Nosworthy's attitude towards his subject is throughout scientific and up to date, but he is fully alive to the value of the older methods and insists that the student must be thoroughly taught the use of ether and chloroform before

he is allowed to extend his experience to other drugs The author has a high opinion of the value of carbon dioxide in many conditions, especially for producing separation of the vocal cords He commends cocaine (10 or 20 per cent) as a spray to the throat to prevent laryngeal reflex, especially before laparotomy, and this measure, which originated we believe with Magill, is certainly not used as often as it deserves to be, its efficacy in aiding abdominal relaxation is remarkable Dr Nosworthy does not fail to point out the care that is needed to obviate inhalation of foreign matter when the larynx is thus deprived of its reflex

In discussing the peripheral causes of respiratory arrest Dr Nosworthy shows admirably how some of the most modern methods may cause, if ill-applied, the very trouble they are designed to remove For spinal analgesia Dr Nosworthy prefers percaine and stovaine to novocain His advice on the choice of the appropriate anæsthetic in various conditions, premedication, and after-effects is concisely expressed and extremely helpful Indeed, one of the most attractive features of this excellent little book is that it contains no superfluous words The print is of a capital size and clearness, and the illustrations plentiful, but the reader is not wearied by detailed descriptions of a large number of different machines all designed on more or less the same principle Although expressly intended for the student this book is likely to give a profitable hour to any of our readers who peruse it

OBITUARY

WILLIAM HOWARD JONES, M B , B S (Lond),

Surgeon Anæsthetist, Charing Cross

THE death in tragic circumstances of Howard Jones removes a man who had made his name as an anæsthetist known and respected not only in his own country but also widely on the continent of Europe Born in 1880 Howard Jones was medically educated at Owens College, Manchester, and St Bartholomew's Hospital, and took the M B , B S (London) in 1913 Subsequently his professional life was entirely given up to the study, practice and teaching of anæsthetics He held anæsthetic appointments at the London Temperance, Royal Ear, National Orthopædic, and Gordon Hospitals, in addition to his main post of surgeon

Anæsthetist to Charing Cross Hospital, Jones contributed several valuable articles to the literature of his speciality, and his views were always distinguished by the logical and often witty manner in which he displayed them The work by which he will be chiefly remembered is no doubt that which he carried out in connection with percain Our readers will remember his paper, "A new regional and spinal analgesia, with special reference t high thoracic nerve root block and a new technique," which ppeared in 1930 From that time until his death Jones conti ued to study, improve and describe his method of using p cain for spinal -- gesia, and he gained many disciples and much prais lucrative practice did not follow in just pr addition to his other labours, Jones was, h secretary to the Association of Anæsthetists and Ireland, and did in that capacity

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unpaid work, unpaid except by the gratitude which he received in full measure from his colleagues

They and many other anæsthetists will long hold in memory the name of Howard Jones as that of a fine clinical worker and a most unselfish, loyal and enthusiastic colleague To his widow and sons we beg to offer our deep sympathy in their great loss

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